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FURTHER OBSERVATIONS ON THE EFFECT OF CERTAIN CHEMICALS UPON OVIPOSITION IN THE HOUSE FLY (*MUSCA DOMESTICA*.)

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In a previous article[1] dealing mainly with the effect of carbon dioxid and ammonia on house-fly oviposition, the writers described the general conditions under which the experiments discussed in the present article were continued during the summers of 1918 and 1919.

The substances used in the present series of experiments, however, are less volatile than those used in the previous ones and for this reason the writers dispensed with the compressed-air chambers previously described and placed the funnels bearing the oviposition medium over milk bottles one-third full of tap water. In these cases the attractant was applied in solution direct to the medium, which was bran husk washed and sterilized as before immediately previous to use. The checks used in all cases were treated in exactly the same manner, excepting that they received a corresponding volume of tap water instead of the solution of the attractant.

Ordinarily a row of 12 units of the foregoing apparatus was employed, the water-treated checks alternating with the attractant used at the time. Occasionally when the total number of flies in the cage was small, only six units, three of the check and three of the attractant, were used.

It seemed better to adopt a standard check against which to try all attractants than to endeavor to work out any scheme of checking by

[1]Crumb, S.E. and Lyon, S.C. The effect of certain chemicals upon oviposition in the house-fly (*Musca domestica* L.). In Journ. Econ. Ent., V.10, no.6, p.532-536, fig. 27. 1917.

trying one attractant against another. The results on different substances should therefore be directly comparable with one another.

In regard to strength of solutions of the different substances used, it should be stated that with the exception of sodium carbonate, sodium sulphate, and calcium hydroxid, they were made of approximately equal chemical strength; that is, the potential hydrogen ion or equivalent was the same in all cases, and equal to that in a 2 percent (by weight) solution of butyric acid. The two salt solutions, sodium carbonate and sodium sulphate were of the same molecular concentration as the butyric acid; that is, double the potential ionic strength. The calcium hydroxid solution was saturated at 20 C. The amount applied to each unit of nidus was from 2 to 4 cubic centimeters. Since the experimental work started with butyric acid, and when it was found that from 2 to 4 cubic centimeters of a 2 per cent solution of this attractant seemed most effective, additional substances were made up and applied on this basis.

In this way it has been possible to test out in a satisfactory manner 13 different substances in addition to carbon dioxid and ammonia; and it is believed that the results in these cases fairly express the oviposition responses of the house fly toward the substances used.

The Results of the 88 experiments made in the two seasons are summarized in Table I.

TABLE I. OVIPOSITION RESPONSE OF THE HOUSE FLY TO CERTAIN CHEMICALS

1918

Inclusive dates	No. of Expts.	Attractant	No. units	Total eggs	Eggs per unit	Per-cent of total
June 20–July 3	11	2–4 cc. 2 percent Butyric acid	50	9,377	187.9	73.5
		2–4 cc. tap water	50	3,373	67.4	26.5
July 5–12	5	2 cc. 1.4 percent acetic acid	30	3,055	101.8	83.8
		Tap water	30	592	19.7	16.2
July 15–20	5	2 cc. 1.1 percent Sulphuric Acid	28	1,726	61.6	37.5
		Tap water	28	2,877	102.7	62.5
July 23–Aug. 3	8	2–4 cc. 1.05 percent Ethyl alcohol	36	3,091	86.9	58.5
		Tap water	36	2,234	62.1	41.5
Aug. 6–21	6	2 cc. 0.62 percent Glycerin	20	1,946	97.3	54.9
		Tap water	20	1,601	80.1	45.1
Aug. 22–Sept.4	7	2 cc. 0.83 Precent Hydrochloric acid	42	2,065	49.2	44.8
		Tap water	42	2,541	60.5	55.2

1919						
June 12–18	6	2–4 cc. 1.7 percent Propionic acid	36	5,025	139.6	64.8
		Tap water	36	2,744	76.2	35.2
June 19–27	6	2–4 cc. 2.0 percent lactic acid	33	1,035	31.3	46.3
		2–4 cc. Tap water	33	1,203	36.4	53.7
June 30–July 7	7	2–4 cc. 1.0 percent formic acid	42	2,183	52.0	66.7
		2–4 cc. Tap water	42	1,086	25.9	33.3
July 8–14	6	2–4 cc. 0.176 percent calcium hydroxide	36	1,618	45.0	42.8
		2–4 cc. Tap water	36	2,167	60.0	57.2
July 15–23	6	2–4 cc. 1.0 percent sodium hydroxide	36	3,575	99.0	75.8
		2–4 cc. Tap water	36	1,139	32.0	24.2
July 24–Aug. 1	7	2–4 cc. 2.4 percent sodium carbonate	39	2,998	77.0	94.2
		2–4 Tap water	39	185	4.7	5.8
Aug. 4–15	8	2–4 cc. 3.2 percent Sodium	42	582	12.4	69.6
		2–4 cc. Tap water	42	228	5.4	30.4

Since the dosages are equal and the chemical concentration of the different attractants is approximately the same, a better view of the comparative effect may be obtained by eliminating the checks, and listing the substances used with their corresponding percentages. Stated in this fashion and listed in the order of diminishing attractiveness the results appear as follows:

		Percent.
1.	Sodium carbonate	94.2
2.	Carbon dioxid (carbonic acid)[1]	92.4
3.	Acetic acid	83.8
4.	Sodium hydroxide	75.8
5.	Butyric acid	73.5
6.	Sodium sulphate	69.6
7.	Formic acid	66.7
8.	Propionic acid	64.8
9.	Ethyl alcohol	58.5
10.	Glycerin	54.9
11.	Lactic acid	46.3
12.	Hydrochloric acid	44.8
13.	Calcium hydroxide	42.8
14.	Sulphuric acid	37.5
15.	Ammonia (ammonium hydroxid)[1]	32.6

[1]Experiments carried on in 1917.

In the case of sodium carbonate, standing first, it is believed that the results obtained in 1917 with carbon dioxid have been confirmed. Since the results with the two substances are practically identical, the marked results obtained with sodium carbonate and its chemical kinship to carbon dioxid led to an investigation of the degree of acidity developing in the moistened bran bait during the 6-hour period of exposure. Additional similarly prepared check units were exposed but screened from the flies. Tested before exposure these units were neutral to phenolthalein. At the end of the 6-hour period of exposure they showed an acidity measured by the same indicator, practically equal to the alkalinity obtained by the dosage used in the sodium carbonate units. Thus it seems possible that a complete liberation of the carbonic acid present in the sodium carbonate units must have taken place, and that the presence of this free carbonic acid in the moist bran bait accounts for the fact that 94 percent of the eggs were obtained in these units. Hence the writers' conclusion that this is a confirmation of their former results with carbon dioxid.

Sodium hydroxid is also a moderate attractant, but, much as is the case with the sodium carbonate, the effect obtained is secondary to a chemical change which occurs in the course of the experiment. The sodium hydroxid doubtless rapidly absorbs carbon dioxid from the air, being converted into the carbonate, which in turn is acted on by the organic acid formed by fermentation in the moist bran medium. This sequence of changes would result in accumulation of a moderate amount of free carbonic acid in the bran medium as before. It will be noted that the calcium hydroxid solution proved of no effect in stimulating oviposition. As to why the same result was not obtained here as in the cases of sodium hydroxid and sodium carbonate it must be observed that the saturated solution of calcium hydroxid at 20 C. is approximately only a 0.17 percent solution and therefore less than one-sixth the equivalent chemical strength of the sodium hydroxid and carbonate solutions. Therefore the amount of carbon dioxid absorbed and converted into free carbonic acid in the acid bran nidus is probably negligible. In fact it is doubtful whether the same chemical change would occur in full, with even the same amount present, due to the relative insolubility of the calcium carbonate when formed.

In the case of sodium sulphate, a moderate attraction is to be observed. The results with this substance are the least satisfactory of the series however, on account of the relatively small number of eggs obtained, incident to weather conditions and inability to secure many gravid flies. Considering together, sodium sulphate, sodium carbonate, and

sodium hydroxid, the writers' conclude that the sodium ion is not a repellent to house-fly oviposition and its presence in some salt combinations may be moderately attractive.

Of the remaining substances in the list receiving more than 60 percent of eggs, all are fatty acids and therefore chemically kin to carbonic acid. Of these acetic acid leads by a wide margin and it is worthy of note that this is the acid most likely to occur in the ordinary decomposition processes of vegetable matter where carbon dioxid is also liberated.

Gravid house flies appear to be indifferent to the presence of the organic bases, grain alcohol and glycerin, as might also be stated of the mixed compound lactic acid. The mineral acids, hydrochloric and sulphuric, appear to be moderate repellents.

In the light of present results the writers' suggest that the female house fly is attracted for egg laying by decaying organic matter in proportion to the amount of carbonic and acetic acids liberated in the fermentation processes, and that the preference for decaying vegetable rather than animal matter may have its explanation in this fact. Also it is possible that its predisposition for these two acids may explain the fondness of the house fly for human environments generally, particularly dwelling houses and livery stables.

DUSTING VS. SPRAYING FOR THE CONTROL OF INSECT PESTS ON THE AVOCADO[1]

By G. F. MOZNETTE, *Bureau of Entomology, U. S. Department of Agriculture, Miami, Florida.*

The Avocado which is now being propagated quite extensively on a commercial scale in Florida has like all other fruits a number of injurious insect enemies. It is during the dry winter months particularly, while the trees are dormant that the grower of this fruit often experiences serious trouble with a number of enemies which attack his trees. Among these enemies may be mentioned the Avocado Red Spider, *Tetranychus yothersi* McGregor; the leaf thrips commonly called in the North the greenhouse thrips, *Heliothrips hemorrhoidalis* Bouche' and the leaf hopper, *Empoasca minuenda* Ball. The red spider and the leaf thrips confine their attacks to the upper surface of the foliage, while the leaf hopper does its work on the lower surface.

During the seasons 1918 and 1919 a number of tests were made with a view to ascertaining the relative merits of several contact insecticides in the dust or powdered form alone and in combination, with similar contact

[1]Published by permission of the Secretary of Agriculture.

insecticides in the liquid form in the control of the above mentioned pests which attack the avocado. A portion of a large grove consisting mainly of the Trapp and Pollock avocados of West Indian strains, which were considerably infested with all the mentioned insect pests was selected for a comparison of the two methods.

In conducting the dusting operations the equipment used was the regular orchard power duster. At the time the applications were made the weather was clear and the foliage was dry. The temperature averaged between 75 and 80 degrees Fahrenheit. The dust was so directed on the windward side of the trees so as to cover the trees well, and the machine was never allowed to stop except at a large tree to be certain it was well covered.

The spraying work was performed the same day a power outfit being employed, using one of the spray guns at a pressure ranging from 225 to 250 pounds.

In the dusting experiments several kinds of material were used among which was an impalpable sulphur dust. This sulphur dust is nearly pure sulphur very finely pulverized and capable of going through a 200 mesh screen. The other material used was a combination consisting of the above dusting sulphur impregnated with a quantity of nicotine sulphate, 40% solution, in the form of Black Leaf-40. Both of these dusting materials are manufactured and on the market as contact dusting insecticides. In the spraying work several sprays were tried out in comparison with the above dusts as lime sulphur solution one gallon to fifty gallons of water, and lime sulphur solution at the rate of one gallon to fifty gallons of water in combination with Black Leaf-40 at the rate of one gallon to nine-hundred gallons in the diluted lime sulphur solution. A portion of a block was left as a check experiment.

Subsequent examinations at various intervals of the dusted and sprayed portions of the grove showed that the dusting method, where the dry dusting sulphur in an exceedingly pulverized form was used, to be equally as effective as spraying with lime sulphur solution against the avocado red spider, *Tetranychus yothersi* McGregor. The mites were not killed immediately, however, on the dusted trees, but after thirty minutes practically all the mites were killed. On examination of the foliage with a hand lens the sulphur was very evenly applied, no portion of the upper surface of the foliage being free from the fine sulphur. In the dusted portion of the grove with the dusting sulphur, the red spiders again made their appearance after a period of five weeks, which was also true approximately in the block where the lime sulphur

solution, one gallon to fifty gallons of water was applied. The weather following application of the dusts was rather dry although for several days following very heavy dews occurred which wet the foliage thoroughly, and a week later a heavy shower occurred in the grove. These heavy dews and shower had very little effect on the sulphur dusted trees in removing any of the dust. Where the lime sulphur solution was applied it killed the red spiders by contact almost immediately, and proved satisfactory in controlling the red spiders over as long a period as did the sulphur dust.

Where a large acreage of avocados exists, and the red spider is the only pest with which the grower has to contend, the dusting method would make it possible for the grower to protect his orchard at critical times from the attacks of the red spider. The dusting method is by far the quicker method.

There are other pests, however, with which the avocado grower has to contend with such as the leaf thrips, *Heliothrips hemorrhoidalis* Bouche' and the leaf hopper, *Empoasca minuenda* Ball. Neither the dry sulphur dust or the liquid lime sulphur had any effect in ridding the trees of the leaf thrips or the leaf hoppers. These two insects are usually present and causing damage to the trees at the same time generally that the red spider is carrying on its depredations, and which are not destroyed by applications of sulphur in the dust or liquid form. To possibly control these by the dusting method the writer procured a dusting material consisting of the finely pulverized sulphur dust charged with nicotine sulphate, 40% solution, in the form of Black Leaf-40. This material was dusted in the same manner as was the dry dusting sulphur. This combined material killed readily the adult and immature red spiders, leaf thrips and a good majority of the leaf hoppers. The material, however, did not adhere to the foliage for any length of time, even the heavy dews removing the majority of the dust. This apparently was due to the incorporation of the liquid nicotine sulphate to the dry pulverized sulphur causing the sulphur particles to aggregate and forming a wettable sulphur. In the case of the dry dusting sulphur, it is due to its fineness and dry condition when applied that it adheres so well to the foliage. The continued heavy dews and subsequent shower removed the majority of the combined dust from the foliage, and it was but a short time after application that the red spiders were again present on the trees in goodly numbers. This is readily explained as nothing effective remained on the foliage to destroy the young which later hatched from the eggs not destroyed by the dust. Hence it is essential, that

the dust remains on the foliage for a sufficient length of time after application in order to destroy the young mites as they hatch from the eggs.

In combining the lime sulphur solution at the rate of one gallon of the stock solution to fifty gallons of water with the nicotine sulphate 40% solution at the rate of one gallon to nine hundred gallons in the diluted lime sulphur solution, this combination proved an excellent spray in killing the red spiders, thrips, and leaf hoppers. The lime sulphur solution in this combination proved effective over as long a time as did the lime sulphur alone against the red spiders on the trees. Examination of the check plot showed the red spiders, thrips and leaf hoppers alive.

Comparative Cost of Spraying and Dusting

During the time the comparative experiments were made a few figures were taken on the cost of the different dusting and spraying materials employed, and the time required to dust and spray 100 average avocado trees nine years of age.

Comparative Cost of Spraying and Dusting

Materials	Average amt. used per tree	Price per pound or gallon	Price per tree	Time required to apply to 100 trees	Cost labor 2 men at $6.00 per day	Cost materials and labor per tree
1 Sulphur Dust	1.33 lbs.	$.0375	$.05	50 minutes	$.63	$.0563
2 Sulphur Dust + Nicotine Sulphate	1.33 lbs.	.15	.18	55 minutes	.69	.1869
3 Lime Sulphur Sol. (1–50)	4.16 gals.	.005	.02	2 hrs. 40 mins.	2.00	.04
4 Lime Sulphur Sol. (1–50) + Nicotine Sulphate (1–900)	4.16 gals.	.02	.08	2 hrs. 50 mins.	2.13	.1013

Conclusions

1. The dusting method with dry sulphur was found to be equally as effective in controlling red spiders on avocado trees over as long a period of time as the spraying method with liquid lime sulphur solution.
2. The experiments proved that it is not necessary that the foliage of the avocado be wet with dew in order that the dry dusting sulphur be effective.
3. Sulphur in any of the combinations used did not control leaf thrips or leaf hoppers, and nicotine sulphate 40% solution when used alone or combined with either lime sulphur solution or dry dusting sulphur will destroy them.

4. Dry dusting sulphur when charged with nicotine sulphate 40% in the form of Black Leaf 40 and applied to avocado foliage was readily removed by succeeding heavy dews and light rains after application. The incorporation of liquid nicotine sulphate 40% caused an aggregation of the sulphur particles and a wettable sulphur.
5. Liquid lime sulphur solution when combined with nicotine sulphate 40% solution proved to be the most satisfactory combination used in combatting the red spiders, leaf thrips and leaf hoppers and remained effective against the red spiders over as long a period as did the lime sulphur solution applied alone.
6. Where a grower has a medium sized grove of avocados, which is usually the case up to the present time, and where a number of insects occur, spraying would be the more effective and cheaper method considering the price of sulphur and nicotine sulphate in the dust form as compared with the same in the liquid form.

CONTROL OF TWO SCALE INSECTS OF THE MANGO[1]

By G. F. MOZNETTE, *U. S. Bureau of Entomology, Miami, Florida*

There are a number of scale insects which attack the mango in Florida, but two found to be the most injurious up to the present time and more generally distributed are the Tessellated Scale, *Eucalymnatus tessellatus* Sign. and the Mango Shield Scale, *Coccus acuminatus* Sign. These two scale insects are readily recognized in the field by the difference in shape and color. The Tessellated Scale is oval in shape, but broadly rounded posteriorly. It is of a dark brown in color, with a decidedly mosaic appearance on the upper surface. The Mango Shield Scale is yellowish green, and in shape it is deltoid, bluntly pointed in front and broadly rounded posteriorly. It is very thin and flat and irregularly marked with black.

Both of these scale insects infest the lower surface of the foliage, usually clustered along both sides of the midribs. When very numerous they may also be found along the lateral veins and the interstices. The scales reproduce continuously throughout the year, the generations overlapping considerably so that at any time one may find the scales in almost any stage of development. During the spring months the scales move from the older leaves onto the new growth of foliage. Usually these are the crawlers, but even the older scales often leave their feeding grounds and wander to the new growth.

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The two scales are quite widely distributed, being found on both the east and west coasts of southern Florida. In Florida the Mango Shield Scale has been found on the mango, roseapple, custard apple, sapodilla and *Allamanda*. It is also found in Grenada, Barbados, Dominica, Antigua, Trinidad, Jamaica, and British Guiana where it infests in addition to the host plants mentioned in Florida the breadfruit, *Jasminum*, *Ixora*, star plum, star apple and the nutmeg. The Tessellated Scale has been found to infest the mango, cocoanut and roseapple in Florida. In the West Indies it also infests *Caryota urens* and many other palms.

Both of these scale insects produce an abundance of honeydew. The sooty mold fungus develops in this honeydew deposit, giving the mango tree in the course of time a decidedly blackened appearance. The sooty mold often collects on the fruit as well as the foliage, giving the fruit a blackened and unsightly appearance. The writer has observed several groves where the sooty mold was so numerous that even the branches and trunks of the trees were blackened by it.

Results Obtained with Insecticides

In testing out the following insecticides, badly infested trees were selected averaging from twelve to fourteen years of age with an average heighth of from twenty-five to thirty-five feet. In each case the spray was directed toward the lower surface of the foliage, using a spray gun with a pressure of from 225 to 250 pounds.

Lime Sulphur Solution

In applying this insecticide to the mango at a strength of one gallon of lime sulphur solution to forty gallons of water in December while the trees were dormant and again in March at a strength of one gallon of lime sulphur solution to fifty gallons of water, it was found, that it did not effectively destroy the scales. The spray killed about 50% of the scales present on the trees, and did not remove the sooty mold present. Due to the tenderness of the mango foliage it was found that the strength of the spray could not be increased.

Caustic Potash Fish Oil Soap

This insecticide was applied to the mango at the same time and interval as the above spray at a strength of twenty pounds of caustic potash fish oil soap to one hundred and twenty-five gallons of water. The same strength was used during both applications. The results

showed that about 80% of the scales were killed. The soap did not cleanse the trees of the sooty mold, and slight spray injury was noticed after each spraying, especially on the sunny side of the trees.

Miscible Oil

The miscible oils, of which there are a number on the market, when used at a strength of one gallon to seventy gallons of water during December and repeating with a spraying at a strength of one gallon of miscible oil to eighty gallons of water during March killed approximately 80% of the infestation on the trees sprayed. The miscible oils, however, vary considerably in composition; at times they contain harmful ingredients which may cause foliage injury. The miscible oils did not seem to spread as effectively as the oil emulsions described below which perhaps accounts for the greater percentage of kill where the oil emulsions were used.

Paraffine Oil Emulsion

A number of paraffine oil emulsions as are used against citrus insects were used. They were applied at the rate of one gallon of the stock solution to seventy gallons of water during December and repeating with another spraying during March, using a strength of one gallon of the stock solution to eighty gallons of water. Results showed that from 90% to 95% of the scales were killed where thorough applications were made.

There are a number of oil emulsions on the market, some of which when combined with the waters used for spraying purposes in southern Florida work very satisfactorily. The waters generally used for spraying purposes in southern Florida come from deep wells in limestone formation and are termed "hard" while those which come from surface wells are as a rule somewhat brackish. There are, however, certain oil emulsions, which when mixed with these waters prove unsatisfactory, because the various salts present in the waters tend to break up the emulsions, causing oil to be set free. This free oil is detrimental to mango foliage and will cause severe foliage injury. If an oil emulsion, which does not perfectly mix with these waters, is used, considerable inconvenience is experienced by the gradual rising of free oil to the top of the tank. This finally becomes more or less gummy, and the working parts of the pump and machine are so coated with it as to hinder spraying operations. In southern Florida, when oil emulsions are used on the mango, it is advisable to test thoroughly to see that no separation occurs, if separation

occurs the water should be first softened by means of caustic potash fish oil soap. This soap has been found to be satisfactory for this purpose by adding four or five pounds to each 125 gallon tank of hard water. There are, however, a number of oil emulsions which contain the proper stabilizers, incorporated in their manufacture, which prevent oil from separating when combined with "hard" waters, thus doing away with the expense of initially softening the water.

Recommendations

Barring some of the difficulties which may be experienced with the use of paraffine oil emulsions, they have proven the most satisfactory and efficient. The trees are cleansed thoroughly of sooty mold through their use. The writer has found that a paraffine oil emulsion applied in December at a strength of one gallon of stock solution to seventy gallons of water followed by another in March at a strength of one gallon of stock solution to eighty gallons of water, gave good results toward controlling the scales on the mango. A great deal depends upon the thoroughness with which the sprays are applied.

ARIZONA WILD COTTON OR THURBERIA AND ITS INSECT ENEMIES IN RELATION TO THE COTTON INDUSTRY OF THE SOUTHWEST

By A. W. Morrill, Ph. D., *Consulting Entomologist, Los Angeles, Cal.*

The recent appearance of the Arizona wild cotton or Thurberia boll weevil[1] in several cultivated cotton fields near Tucson, Arizona and the uncertainties in regard to the extent of the infestation, also the uncertainties in regard to the probable infestation of cultivated cotton in the Southwest by the Thurberia bollworm[2] constitute a serious menace to the cotton industry of the Southwest, and at the same time serve as an object lesson in the handling of complicated insect problems. A review of the facts in regard to the situation referred to will place on record a statement of entomological principles involved in the wild cotton problem and tend to prevent further meddling by politicians with matters involving grave dangers to agricultural industries and which properly belong to the field of economic entomology.

That the Thurberia weevil is evidently better adapted to the climatic conditions of the arid and semi-arid southwest and consequently a more serious menace to cultivated cotton in that region than the eastern

[1] *Anthonomus grandis thurberiae* Pierce [2] *Thurberiphaga catalina* Dyar

variety of the boll weevil[1] has been repeatedly pointed out in various publications following the early investigations of the problem, principally by Dr. W. D. Pierce and the writer in 1913[2] and Mr. B. R. Coad in 1914. The possibility that the Thurberia weevil might not be able to adapt itself to lower elevations than its known habitat in the mountains of Southern Arizona provided a basis for a certain amount of optimism but the seemingly well grounded hope that the insect might be restricted in its future distribution by the factor of elevation was dissipated in 1916 by the discovery of the Thurberia weevil at sea level in Sonora, Mexico, by Mr. E. A. McGregor. A maximum longevity record of 626 days for the Thurberia weevil brought to my attention by Dr. Pierce in correspondence has further emphasized the peculiar status of the insect as a potential pest of cultivated cotton. Fortunately, under natural conditions, the relation of the food supply to the weevil in the native habitat of the latter has been such that as long as the "status quo" of the insect and its native food plant was undisturbed, the danger of infestation of cultivated cotton in the valleys was practically limited to water transportation by means of floods from the mountains. The ill advised disturbance of this generally satisfactory relation by an eradication campaign directed against the plant rather than its insect enemies, even followed as it was by a season of unusually light rainfall and absence of floods reaching into the valleys, made infestation of cultivated cotton by flight of the insects, practically inevitable. The discovery of the weevil infestation in cotton fields in October 1920, bore out a prediction made with the utmost confidence by the writer after an investigation of the situation several months earlier.

While the Thurberia boll weevil has been generally considered the most noteworthy of the pests of the Thurberia plant, the potential importance of the Thurberia bollworm[3] has never been questioned and it is obvious that the existence of the latter in the same localities as the weevil, introduces a complicated problem which must be taken into consideration in any intelligently planned attempt to eradicate the weevil and its host plant in any area. It is of interest as a side light on the situation that, according to a statement made to the writer by Dr. C. T. Vorhies of the University of Arizona, the Thurberia bollworm was not discussed or considered in connection with the planning of the eradication campaign which was done at a conference he attended early in October, 1919.

The rapid development of the cotton industry in the Southwest having made desirable a reconsideration of the wild cotton problem

[1] *Anthonomus grandis* Boh.
[2] Pierce and Morrill. Proc. Ent. Soc. Wash. vol xvi, pp 17–19, 1914.
[3] Morrill, Fifth Annual Rept. Ariz Comm. Agr. and Hort. p 47, 1914.
Morrill, Jour Econ. Ent. vol. x p 312, 1917

in Arizona, a survey of the distribution of the plant was made in certain districts adjoining cultivated lands near Tucson in the summer of 1919. It was expected that this survey, when completed, would serve in connection with entomological surveys as a basis for determining what, if any, protective measures might be practicable and advisable. Ignoring very elementary factors in the insect problems as set forth in the several publications on the subject, the Arizona officials planned and began in October 1919 a Thurberia eradication campaign near Tucson. Eradication work was referred to as follows in an official statement issued in November, 1919: "This office is actively engaged in the eradication of the Thurberia. . .in the washes of the Santa Catalina mountains. . . . The problem is well defined, the plant in the lower altitudes grows only in the washes and canyons. A competent man to superintend the work, a number of Mexican laborers, picks and a bar constitute the necessary equipment. The plants are being pulled or dug out and root and top burned." In a statement made public on May 11, 1900 the eradication work accomplished and plans for further activities were described as follows:

"Last summer a survey of the wild cotton plant and its eradication in the washes of the south and west slopes of the Santa Catalina Mountains and the west slopes of the Santa Rita Mountains was undertaken under the direction of the State Entomologist.

"With a view to safeguarding the cotton industry of the districts adjacent to where Thurberia grows, the Commission has decided to continue the work of eradicating the wild cotton plant and as an additional safeguard, to establish a zone within which no cotton may be planted during the coming season."

For the information of business interests related to the cotton industry, the writer, early in 1920 began an investigation of the wild cotton situation and discovered that a condition very dangerous to the cotton industry of the Southwest had been created. In order to reduce the problem to its simplest terms and show the unprejudiced views of professional entomologists concerning the action of the Arizona authorities, a questionnaire was prepared and sent to several members of the Association of Economic Entomologists. The conditions stated in the questionnaire were carefully compared with the literature on the wild cotton by two other members of the Association. The answers to the questionnaire were all in agreement and written statements were secured certifying that the conditions as stated, agreed with the literature

on the subject. The following is a copy of the questionnaire[1] with the most terse representative answers:

"A valuable agricultural crop A is grown in valleys near mountain ranges where a closely related plant B is widely scattered with a natural range extending down to within less than five miles of cultivated land in some cases. Plant B is known to be generally infested with two destructive insect pests, a weevil X and a moth larva Y which are known to attack the cultivated plant, A, whenever available, exhibiting no noticeable preference between the two food plants. Investigations of these two insects by state and U. S. Government entomologists have lead to warnings concerning the danger to the cultivated crop A.

"Plant B grows scatteringly over thousands of square miles of drainage country and investigations have led to the conclusion that infested parts of the plant are frequently washed down by water flow from the higher altiudes. In some cases, the water even when in considerable quantities disappears in the sands in the lower ends of the canyons leaving debris which is supposed to frequently include parts of plant B infested with X. In such cases it is logical to suppose that the specimens of the weevil X thus transported are attracted by plants B growing in the vicinity and the cultivated crop A is thus under natural conditions protected against the danger of infestation by flights which would be forced if none of the wild food plants B were naturally growing in the vicinity near where the infested plant material is deposited by the water.

"Plant B naturally produces a great abundance of food for all insects which attack it and under normal conditions it is evident that migrations of such insects never result from a shortage of food supply. This abundance of food has doubtless in the past acted as a protection to crop A.

"The adult of insect Y is unknown but the larva is robust and apparently is that of an active noctuid moth which has been supposed to be capable of flying a considerable distance. Two entomologists, specialists on insects affecting crop A who conducted the principal investigation of insects affecting plant B reported in an article published in a scientific journal that insect Y was even more destructive to its food plant than insect X, the inference being that Y was even more to be feared as a potential enemy of crop A than was insect X.

[1]Questions 5 and 7 are omitted in order to save space.

"The active period for the adults of insects X extends from July 1 to November 15th[1] varying with the elevation and climatic conditions. The adults hibernate inside the ripened and dried fruit of plant B. The adults of insects Y are active during July and August, the worms going into the ground in September and October where they transform to pupae, in which condition the insects spend the winter. The larvae reach full size and go into the ground between September 1st and October 15th according to present knowledge of the insect's life history.

"So far as known neither insect X or insect Y has any other food plants than A and B. Crop A is grown in several irrigated valleys of limited acreage separated by stretches of desert of from 50 to 100 miles in each case. The total value of crop A grown within 250 miles of this locality is above fifty million dollars. The plant B is found in the close proximity to only one of these valleys.

"With the foregoing conditions in mind will you please give your opinion in regard to the following points:

1st. If there were no other insect or insects than weevil X to be considered, during what period of the year could the destruction of food plant B by "chopping out" and burning the plant be carried out over the whole or a part of the insects' range without danger of forcing a migration of adults to crop A?"
REPRESENTATIVE ANSWER: "November 15 to July 1"

2. If there were no other insect than Y to be considered, during what season, if any, could the destruction of food plant B be carried out over a whole or a part of its range without danger of forcing a migration of the insects to crop A?"
REPRESENTATIVE ANSWER: "Destruction to be of value should be conducted during July and August, leaving trap plants which should be sprayed or the larvae feeding on them killed. Destruction of the plants between September and following July would probably force migration of moths coming from hibernation in soil."

3. Assuming that the worms and pupae of Y in the ground near the plants thus destroyed were left undisturbed and assuming that no attempt was made to collect the adult weevil X from the plants before they were chopped out by common laborers, what would be expected as a natural consequence if the wild food plants, B, were destroyed during October and November?"[2]

[1]The first killing frost may be considered as definitely ending adult weevil activity. The average date of this at Tucson is November 22.

[2]The eradication campaign was started on or about October 13, 1919. Fortunately, the first killing frost occurred on November 9.

REPRESENTATIVE ANSWER: "Would destroy few of X and none of Y and would probably force search of food within range of flight of insects X and Y."

4. Would it be logical and advisable to destroy the plants B growing within five or six miles of the mouths of the canyons (where infested debris containing weevils X is supposed in many cases to be deposited by water) before the plants B are destroyed higher up on the water shed?"

REPRESENTATIVE ANSWER: "No. Should be left as trap and insects destroyed."

6. Would you characterize the destruction of plants B at the lower ends of the canyons and adjoining washes during October and November, with no attempt to collect the adults of weevil X or destroy the larvae and pupae of moth Y in cells in the ground near the food plants or to destroy the plants at higher elevations as (*a*) a logical and highly commendable action likely to prevent infestation of crop A. (*b*) as a matter of little consequence from any standpoint or as (*c*) a colossal blunder diametrically opposed to good entomological practice and seriously threatening to agricultural interests?"

REPRESENTATIVE ANSWER: "As (c)."

No one, prejudiced or unprejudiced, has found any detail of the conditions stated in the questionnaire which does not correspond in all essential points with the several publications relating to the subject. However, it should be pointed out that in the second paragraph it would have been more in accord with the facts to have stated that in "most" rather than "some" cases, the water even when in considerable quantities disappears in the sands in or near the lower ends of the canyons.

Wide experience with the cotton boll weevil has demonstrated that narrow non-cotton zones, such as the Arizona officials have attempted to maintain, are worse than futile in stopping the progress of the weevil. In general, the weevil will cross a five or ten mile non-cotton zone faster than it would cross the same area planted entirely in cotton. The weevil and food plant relationships having been disturbed during a critical period and at a place where most easily thrown completely out of adjustment, the outlawed cotton plantings which became infested evidently served a most valuable purpose as trap crops. Unfortunately there were too great intervals between these outlaw fields. Under the circumstances which existed the more cotton grown in the prohibited

area the better would be the protection of the vastly more important cotton sections within range of flight of the two insects here discussed. However, the direct results of migrations of weevils forced in the fall of 1919 have not yet been ascertained since the inspections in the field have covered only an insignificant fraction of the total number of cotton stalks. In Pima county alone there were approximately forty million stalks and the 188 man-days spent in field inspections could not have been equivalent to the thorough inspection of a hundred thousand of these. If the assumption is correct that no infestations exist in Arizona out-side of the fields where the weevil was actually found, the protective value of the outlaw cotton was greater even than I had supposed.

Necessary space limitations make it impossible to consider here the proper methods of dealing with the wild cotton problem in Arizona. The writer plans to discuss this in other papers on the subject. The more immediate need is for an understanding in political circles of how not to deal with the problem and this paper will doubtless serve a useful purpose in this connection.

OBSERVATIONS ON NATURAL ENEMIES OF THE FALL CANKER-WORM (*ALSOPHILA POMETARIA* PECK) IN FORESTS OF SOUTHERN ALLEGHANY MOUNTAINS, IN 1920

By F. SHERMAN, *Entomologist, State Dept. Agriculture, Raleigh, N. C.*

THE CONDITION

In the years 1917, 1918, and 1919 there were repeated reports of injury by Fall Canker-worm to certain limited areas of wild mountain forests in western North Carolina. Approximately twenty such areas, in nine different counties, were reported,—the areas varying in extent from 10 to 200 acres or more. The injury occurs chiefly in June. Land owners were not familiar with this insect, and were apprehensive lest it should continue to increase and spread until the forests were damaged beyond recovery.

As most of the areas are without roads, with steep slopes and often with much miscellaneous undergrowth, such methods as banding and poisoning were out of the question. It was therefore decided to make a study of the natural enemies during June of 1920. The area selected was on the summit of Hump-back Mountain in Avery County, N. C., 4,170 feet elevation, giving conditions suggestive of the more northern states—Transition Life-Zone, bordering on the Canadian. The observation covered the period from May 27 to June 24, 1920.

Birds

A total of 53 species of birds were recorded in or near the infested area,—of these the following highly insectivorous Passerine birds were observed so commonly in the area that they could fairly be presumed to be of material help:—

1. Mountain Vireo.
2. Red-eye Vireo.
3. Black and White Warbler.
4. Parula Warbler.
5. Black-throated Blue Warbler.
6. Chestnut-sided Warbler.
7. Black-throated Green Warbler.
8. Ovenbird.
9. Yellow-breasted Chat
10. White-breasted Nuthatch.
11. Tufted Tit.
12. Chickadee (prob. southern form).
13. Wood Thrush.
14. Veery.
15. Robin.

The variety and number of insectivorous birds appeared to increase in the worm area, but the concentration was not so pronounced as one might expect,—evidently there was much insect food outside the area. The above 15 are selected from the total of 53 species. Among the others were many which probably do feed on canker-worms. (The list included Pileated Woodpecker and Brown Creeper, among others).

Predaceous Insects

Calosoma frigidum Kirby. (Coleop. Carab.). Despite much collecting in mountains we had not before taken this species in the state, yet it was found to be common in the worm area, was not found outside of the area, and did become increasingly conspicuous. They were often seen climbing among the twigs and foliage of infested trees, not only on cloudy days, but on clear days as well,—this was especially so when the worms became less numerous by reason of maturity. This species easily takes first rank among the insect predators observed, and in aggregate helpfulness was second only (if second) to the egg-parasite mentioned later. Its general distribution is northerly.

Calosoma scrutator Say. Found only the remains of one dead specimen.

Podisus modestus Dall. (Hemip. Pentatom.). This northerly bug takes second rank among the predators,—it was common, or rather, abundant,—and specimens were often seen with worms impaled on their beaks. It is widely distributed through our mountains.

Lygus sp. (Hemip. Capsid.). One or more species of these were abundant, and several were seen with worms impaled on their beaks.

Ants, (2 sizes, black). Twice seen dragging worms.

Panorpa sp. (Neurop.). Several species were abundant, one was seen devouring a worm.

Parasitic Insects

Telemonus sp. (Hymenop. det. A. B. Gahan). Early in this study a number of egg-masses of Fall Canker-worms were collected from which the larvae had hatched. It was observed that perhaps 25% to 40% of the eggs had not yielded larvae. From these this parasite was easily reared. This was apparently the most useful parasite. It is uncertain whether this or *C. frigidum*, should be given first rank among the natural enemies, in total good accomplished.

Euplectrus sp. (Hymenop. det. A. B. Gahan). Several Canker-worms were found with very small external parasitic larvae attached. From one of these this species was reared.

Sarcophaga cimbicis, or, *latisterna*, (Dip. Tachin.). One specimen was reared from Canker-worm. The specimen is female, and *may* be either of the above species. (det. J. M. Aldrich).

Collected Species

During the study six species of Tachina-flies were collected in the worm area,—of these *Masicera eufitchiae* Twnd. was common. Also eight species of Ichneumonidae were taken among which were four species of *Amblyteles*, which may be parasitic to canker-worm, — the others were larger species which probably do not attack it.

Fungous and Bacterial Disease

It had been expected that these would be in much evidence by this, the fourth successive year of attack. This did not prove to be the case, although warm and damp weather was not lacking. Only an occasional worm was found which seemed to have perished from disease, and there was no hint of an epidemic among them. This condition may yet develop.

* * * * * *

While the canker-worms were present in countless numbers, yet residents testified (and evidences were observed) that the defoliation was not so complete in 1920 as it had been in 1917, 1918, and 1919.

It is believed that this was due largely to an increase in the efficiency of the natural enemies, especially *Calosoma frigidum*, *Telemonus* sp., and *Podisus modestus*,—(doubtless others helped), and the small birds. This gives basis for the hope that these may continue to increase, causing a further subsidence of the outbreaks, until the canker-worm may again become inconspicuous. An outbreak of disease among the worms would hasten this result.

The study was interesting and enlightening, and led to an increased appreciation of the unseen good which natural factors accomplish, especially in wild areas like the one under study, where artificial control seems hopeless. The area also proved to be a good one for insect collecting, especially in the family Cerambycidae.

THE EUROPEAN CORN BORER AND THE SUGAR CANE MOTH BORER: A COMPARISON[1]

By T. E. HOLLOWAY, *Entomologist, Southern Field Crop Insect Investigations, U. S. Bureau of Entomology*

Two prominent State Entomologists have recently requested data of the writer concerning the sugar cane moth borer and the similarity in its life history and damage to the European corn borer. After reading the papers and the discussions on the new pest in the Journal of Economic Entomology, the writer decided that possibly he should place the information on the two species in such form as to be readily available for comparison. While the climate of Louisiana is very different from the portions of New England and New York which have been infested by the European corn borer, yet information on the sugar cane moth borer may indicate in some degree what may be expected of the European insect.

SYSTEMATIC POSITIONS

Both insects are of course Lepidopterons of the family Pyralidae. The European corn borer, *Pyrausta nubilalis*, is in the subfamily Pyraustinae, while the sugar cane moth borer, *Diatraea saccharalis crambidoides*, is in the subfamily Crambinae.

DAMAGE TO CORN AND SUGAR CANE

The corn crop as planted in Louisiana is largely out of the way before the maximum development of the sugar cane moth borer is reached. Corn is usually planted about March, and is mature by mid-summer. While holes and tunnels may be found in the stalks, and while any injury to the stalk must have an effect on the ear, still the damage is usually so slight as never to have been estimated. Doubtless the weight of a number of ears from infested plants would be found to be somewhat less than an equal number from uninfested plants. As for the ears themselves, they are rarely damaged by the sugar cane moth borer. A larva is sometimes found to have entered an ear from the stalk, but this damage is negligible.

[1]Published by permission of the Chief of the Bureau of Entomology. Read at a meeting of the Louisiana Entomological Society, June 3, 1921.

All this refers to corn as ordinarily grown. Late corn is often so seriously injured as to be worthless.

As to sugar cane, this crop grows till fall, and beginning about September the damage increases rapidly. It is estimated that the average loss is about 16% of the crop, though it is sometimes as high as 33%.

There is also an injury to young corn and cane plants, the larvae entering the stalks at the surface of the ground or a little below and killing the plants.

From the literature, it would seem that the European corn borer may do much more damage. Caffrey (1) writes: "The larvae or borers of the European corn borer tunnel through all parts of the corn plant except the fibrous roots. They even feed within the midrib and upon the surface of the leaf blades. They cause their most serious damage, however, by their work in the stalks and the ears, which they partially or totally destroy. Generally, they enter the stalk at its upper end near the base of the tassel, and at first tunnel upward. This damage so weakens the tassel stalk that it breaks over before the tassel matures, resulting in loss of pollen and the lack of normal grain formation on the ears. . . . Field counts in badly infested areas have shown as many as 60% of the tassels broken over in this manner."

More recently, Felt (5) writes: "Generally speaking a 30 percent. stalk infestation is necessary to produce marked commercial injury though in some fields with a 10 percent. stalk infestation as high as five percent. of the ears of sweet corn were affected and judging from conditions in other single brooded areas, a 90 percent. stalk infestation of field corn by no means implies the destruction of the entire crop, though it does involve serious damage. There has been in New York State no very serious losses due to the actual work of the European Corn Borer though the 30 percent. to 40 percent. stalk infestation in the more seriously infested areas suggests a probability of increased injury and possibly an approximation to the great damage caused in certain Canadian areas."

Food Plants Other than Corn

The sugar cane species is unlike the European corn borer in that it does not attack various weeds, though it does breed in Johnson grass and other large grasses. On a sugar plantation both corn and sugar cane are grown. The stalks of planted cane undoubtedly supply many moths for the infestation of both corn and sugar cane, as it has been found that the moths can emerge from one half inch of packed soil. In the case of both insects, moths come from a source other than corn.

Progress of Infestation

In a discussion at the meeting of the Association of Economic Entomologists at St. Louis on December 31st, 1920, it was mentioned that the infestation by the European corn borer was extremely low in places. Judging from the related insect, however, the opinion of the writer is that this means very little. If the infestation is very low now it may be some years before there is an important loss, but the loss is probably to be expected.

Some years ago the writer happened to make examinations on a plantation which had previously been under water for a number of weeks, all that section of the country having been overflowed. The infestation of sugar cane in the fall was 4% of the stalks, which would mean that at the time the corn was gathered there was practically not a trace of borers in the fields. The writer made a point of visiting this plantation the following year, and he found that the infestation of sugar cane had risen to 6%. One year later it had climbed to 68%, and the following year it was 87%. With an 87% infestation in sugar cane, late corn would not have been successful.

The writer cannot predict similar activities on the part of the European corn borer, but it evidently develops earlier in the season than the sugar cane moth borer, and even more damage might reasonably be expected of it. It should be pointed out that the sugar cane species is really a tropical insect which was brought to Louisiana in shipments of seed cane, and that it develops much more slowly than do insects which are native to Louisiana. The European corn borer, on the other hand, comes from a region where the climate more resembles that of the northern states, and it apparently reaches a heavy infestation much earlier in the year.

Habits of Adults

Caffrey (1) states: "Soon after emergence the moths mate and begin to deposit eggs. They remain quiet during the day, hiding in patches of grassland or underneath the leaves of plants. At night they fly from plant to plant, depositing their eggs in flat, irregular-shaped masses of from 5 to 50 eggs each, on the underside of the leaf. Each egg overlaps the adjoining eggs in the manner of shingles."

This was written about the European corn borer, but it almost perfectly describes the habits of the sugar cane moth borer.

Number of Eggs

The average number of eggs deposited by the sugar cane moth borer is about 200, while according to Caffrey (1) the average for the European corn borer is 550 for the first generation and 350 for the second. In both species the sexes are about evenly divided.

Generations

The sugar cane moth borer has two to five generations in Louisiana, while the European corn borer has one in New York and two in New England (1, 2).

Feeding Habits

Caffrey (1) mentions the habit of adults of the European corn borer of depositing eggs on dead and dried corn stalks. This never occurs with the sugar cane moth borer, and if it did occur that insect would probably be far more injurious than it is, as there would be many borers carried over the winter in old corn stalks. Careful examinations in Louisiana have failed to prove that there is any hibernation whatever in old corn stalks. As mentioned above, there is little injury to the ear from the sugar cane moth borer, while this is one of the principal forms of injury by the European species. Otherwise, the feeding habits of the two insects are similar, both tunneling in the stalks of their host plants.

Extension of Territory

The sugar cane moth borer has for years remained restricted to about the same territory. It is distributed mainly through shipments of infested seed cane. Apparently, the European corn borer extends its territory very rapidly, according to Felt (2), who points out that the larvae were probably carried in shipments of green corn to summer hotels south of Boston. The shipments of sugar cane outside the area infested by the sugar cane moth borer are negligible, though there is doubtless some shipment of ears of corn for cooking.

Hibernation

Both borers pass the winter in the larval stage in their tunnels, though the sugar cane moth borer is then limited to sugar cane and grasses while the European corn borer hibernates in the cobs and stalks of corn (1). The sugar cane moth borer extends its larval period to as much as 276 days for hibernation. The European corn borer may live for over a year in the larval stage (1).

Natural Enemies

Marlatt (3) brings out the fact that the European corn borer is well parasitized by *Trichogramma minutum*. This efficient parasite attacks the eggs of the sugar cane moth borer, but develops so late in the season that it is not quite an effectual means of control. Nearly 100% of the eggs are parasitized in the late fall, however, which must greatly reduce the number of hibernating borers. The parasite has been rendered more effective by avoiding the burning of the leaves of sugar cane left on the fields after the cane is cut (4). A tachinid parasite is now being introduced from Cuba.

Many Sugar Cane Moth Borers Destroyed in the Manufacture of Sugar

It should be pointed out that every fall the sugar cane in Louisiana, some 300,000 acres, is cut and most of it (except what is used for planting) is ground in the process of making sugar. This kills all the larvae in the stalks, and forms what one might call a kind of "automatic" control. Of course there is no such factor in the control of the European corn borer.

Effect of Arsenical Poisons

As with the European corn borer (1), so with the sugar cane moth borer (4) arsenical poisons are not efficient.

Possibility of Injury from the European Corn Borer

Judging from the comparisons given above, it would seem that the European corn borer will often cause serious damage in the North, while if it should invade the Southern States it may be even more injurious.

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CONTROLLING THE ARMY-WORM IN SOUTHEAST MISSOURI

By VERNON KING AND GEO. W. BARBER, *Cereal & Forage Division, U. S. Bureau of Entomology*

The late Lieut. Vernon King was for upwards of three years a member of the staff of the Cereal and Forage Insects Investigations of the U. S. Bureau of Entomology. For considerably over a year he was in charge of a laboratory located in Charleston, Missouri, and here, with the assistance of the junior author, he carried on investigations of many insects injurious to cereal and forage crops.

Because of the hurried departure of Mr. King in the Fall of 1914 to enlist under the colors of England, his native country, and due to the more or less incomplete nature of his experiments, no contribution from his pen to the literature of American Economic Entomology has been published under his name.

To fill this want, and in justice to the memory of Mr. King, who met death on the field of battle, the junior author has gone over his notes and photographs and presents the following short article as representing a small portion of Mr. King's work. The method of control which is here described is entirely the system developed by Mr. King and the figures are from his photographs.

The region commonly referred to as Southeast Missouri embraces a considerable area of reclaimed, cypress swampland about seventy miles wide and nearly one hundred miles long in Missouri, extending into Arkansas and embracing nearly the entire eastern half of that state. Here, for ages, the Mississippi River has yearly overflowed its banks, adding each year a thin layer of soil. The section is now being fast reclaimed by extensive systems of drainage canals and protected by levees from the overflow of the river. The climate is warm and humid with a large annual precipitation and this region already is beginning to show its importance as one of the principal agricultural sections of the state. Here, also, thanks to the comparatively inexhaustible nature of the rich, black soil, all vegetation takes on a very rank growth and injurious insects become more and more important.

Among the more important insects often injurious to the agriculture in this section, the army-worm, *Heliophila unipuncta*, is almost annually of importance, frequently occuring in large numbers and destroying considerable areas of crops. Often the migration of the larvae is from the maturing wheat to adjoining or nearby fields of young corn, when, unless prompt steps are taken for the control of the insect, the corn is entirely destroyed.

1

2

1. Using the larger log, showing method of "riding."
2. The plow and barrel at work, showing the different appearance of the furrows (Photos by Vernon King).

During the Spring of 1914, the army-worm was very numerous; observed first about May 13th, by the 20th to 23d they began migrating from the wheat into the corn fields, the principal migration occurring at about 2:00 P. M. of the 21st and between 4:00 and 5:00 P. M. of the 23d. So large was the number of larvae issuing from the wheat that they produced a distinct rustle as they moved among the leaves. By May 29th the larvae were entering the soil to pupate and were becoming scarce.

Predatory enemies and parasites were, in 1914, so numerous as to probably destroy from fifty to sixty percent of the larvae.

The bob-o-link (*Dolichonyx oryzivorus*) occurs in such large numbers about the wheat fields where the army-worms are plentiful that the farmers call the species the "Army-worm bird" and believe, evidently with some justification, that their presence always indicates the advent of army-worms.

Calosoma beetles, *C. scrutator*, *C. lugubre*, and *C. calidum* become very numerous indeed during the seasons of great abundance of the army-worm in this region, and were particularly numerous during May of 1914, although by the latter part of June they were scarce and by July were difficult to find.

Toads occur in considerable abundance and undoubtedly destroy large numbers of the larvae, particularly where they congregate in the furrows.

Parasitic flies were, during 1914, very numerous; the principal species being *Winthemia 4-pustulata* and *Frontina aletiae*. Hymenoptera apparently were less abundant although *Apanteles militaris* was quite generally present and was reared in some numbers from the larvae.

Of the various schemes investigated in 1914 to protect the young corn fields from the swarming larvae, the two-furrow plan without post holes appeared most successful on heavy soil. In this system two furrows are plowed along the edge of the corn field adjoining the wheat, or from the direction that the larvae are expected to enter the field. These furrows are about three feet apart and are first made with a one-horse plow, followed with a heavy three-horse plow to throw the earth up towards the side of the corn field, above the level of the ground. The last plow is followed with a log 3′ x 8″ diameter to break up clods in the bottom of the furrow. A second log (Pl. 6, fig. 1) about 16″ in diameter and about two feet long is then drawn through the furrow to smooth the bottom and lower half of the sides of the furrow. Finally a barrel (Pl. 6, fig. 2) dragged through the furrow smooths the sides

still more. At first, it is more or less difficult for the driver to ride astride of the logs and barrel but by balancing himself, by means of two short sticks, one in each hand, the difficulty is soon overcome. The logs and barrel may be used each morning to keep the sides of the furrow pulverized and smooth, in which condition the larvae cannot attain a foothold, and may be used frequently through the period of maximum migration to kill larvae in the ditch.

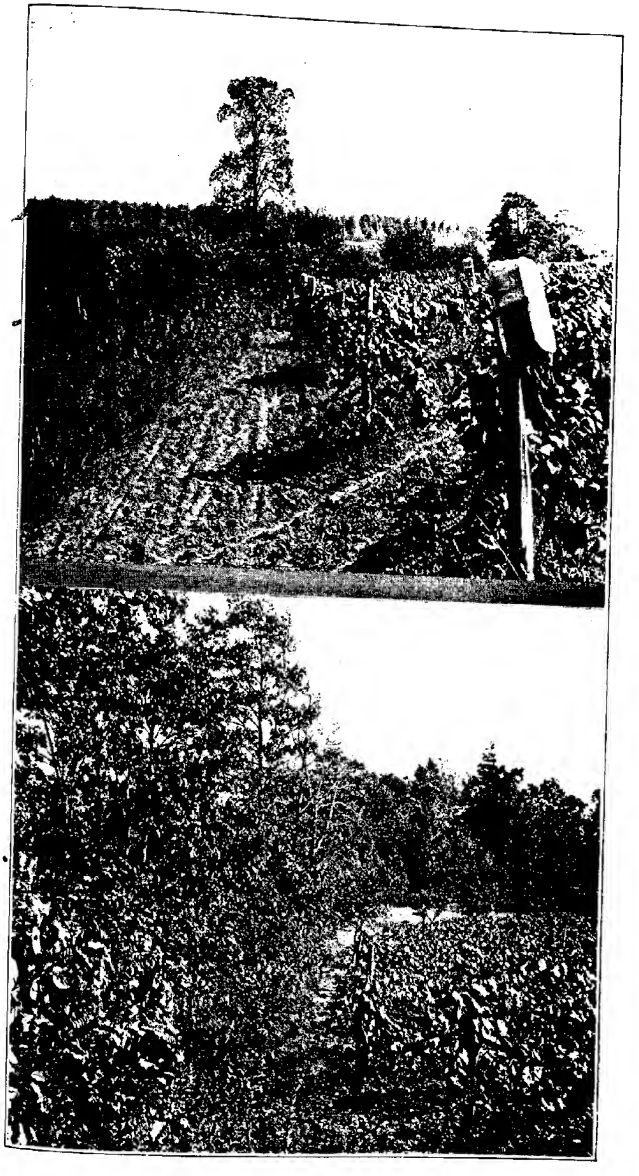
On very light soil, such as is found occasionally in this section, as sandy bars, the ditches with post holes at every fourteen feet serve the purpose, but with post holes the ditches cannot be dragged and the post holes on heavy soils were found to be useless.

FACTORS DETERMINING LOCAL INFESTATION OF THE GRAPE BERRY MOTH

By J. G. SANDERS and D. M. DELONG, *State Capitol, Harrisburg Pa.*

Throughout the great grape growing areas in the Eastern United States especially, the Grape Berry moth has been rightly considered a very important pest. Many years in the aggregate have been spent by a number of men in attempting to control this pest, and all of the experimental work carried on to date has had as its basis the poisoning of the larvae. Although some attention has been given to cultural methods, practically no thorough study has been made of natural conditions under which the moth survives, and little comparison of areas of infestation with those uninfested has been made. The ecological factors often must be considered in the distribution and survival of a pest.

For the past three years, 1918 to 1920 inclusive, a survey and study has been carried on in the North East, Pa., area of the Erie-Chautauqua grape belt, in which an area of approximately thirty-two square miles was given careful consideration, and approximately three hundred vineyards were examined. Vineyards having all types of topography were visited and inspected during these examinations, and adjoining vegetation combined with the various degrees of attention and cultivation were carefully noted. The determination was made of the extent of infestation and the conditions controlling it. It has been definitely shown that grape berry moth infestations occur in the vineyards in a very spotted and localized manner. As a rule a single field is neither entirely nor uniformly infested, and its condition is not an index of the adjoining fields, unless similar conditions occur.



Grape Berry Moth infested Vineyards.

Upper—Vineyard bordered by weedy and uncultivated area.
Lower—A border of woodland and low shrubs.

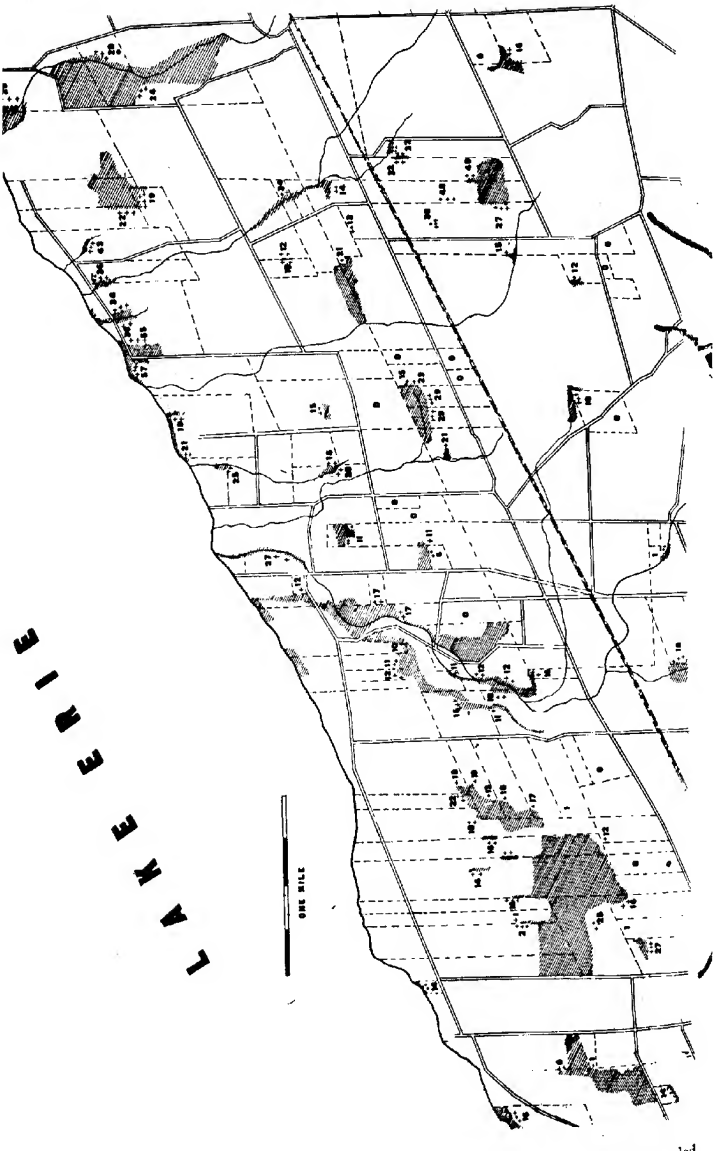


Fig. 10 Diagram of grade region about North East, Pa. Shaded portions show wooded areas and figures indicate percentages of infestation adjoining.

Areas of infestation are due entirely to the existence in the immediate vicinity of conditions which are suitable to the over-wintering of the pupae, which are usually found in dry grape leaves. Conditions favorable to the collection and aggregation of dry leaves—often blown by the wind—are found in weedy headlands, woodlands, uncultivated fields adjoining strips of uncut weeds along the vineyard, or an abrupt depression where snow by drifting can cover the leaves, and thus protect the pupae from freezing. The autumn winds carry the leaves to these grassy and woody areas, where they are held and protected over winter. These facts have been verified by placing numerous grape berry moth pupae respectively in protected and in exposed areas, with the result that those in the open vineyard areas are killed, apparently by freezing and the varying temperatures.

The amount of infestation of these vineyards ranges from zero to fifty-seven percent as a maximum. Perhaps ten to fifteen rows toward the open vineyard showed a very slight infestation or none whatever.

An examination of vineyards throughout the entire area has shown this condition to be practically uniform, and when this condition is observed year after year it is apparent that the infestation does not continue to spread during consecutive years, but that the pupae are killed each year, except in the protected zone. Since the flight of the moths is quite limited, the same areas are reinfested each year from the same source. These vineyards under consideration are generally well cultivated, and little opportunity exists for vegetation to carry overwintering pupae.

During these observations one vineyard was found containing an almost uniform infestation of approximately forty percent. On further consideration it was discovered that this vineyard had not been cultivated for several years, and conditions for overwintering were ideal throughout the vineyard. Abrupt depressions in contour, or swales, occurring in the midst of a cultivated vineyard will furnish the only infestation found in an area of several acres, and the largest percentages of infestation found are caused by a combination of depressions and stretches of abandoned or uncultivated ground, containing a growth of sumacs, brush, or heavy weeds, or a generally wooded area. After a little practice and study of infested areas, these suspicious portions can usually be picked out at a glance over the entire vineyard before clusters are examined.

The direction of the woodland from the vineyard seems to make very little difference, so long as it adjoins the vineyard closely. Slightly more protection, with resulting heavy infestation, seems to be afforded

by a west or northwest wooded area. Little difference is observed whether the grape rows parallel the wooded or waste land strip, or are perpendicular to these conditions in the area affected by the moth, for the spread seems to be uniformly deep under each condition. By reference to the accompanying map (Fig. 10) a remarkable variation in percentages of infestation in portions of the various vineyards will be noted.

During the summer of 1919 spraying and dusting experiments were carried on in the vineyard which had a heavy infestation, and although results were excellent, they were not reliable, for it has been proven that the heavily infested area coincided with the check plot, the only manner in which the relative merits of spray materials can be determined against this pest is to be certain that the areas treated in both cases are uniformly infested, which is not the case throughout this region, except the one uncultivated field mentioned above.

In conclusion it seems only reasonable to believe that the most effective way to control the grape berry moth is by burning over and clearing waste places and head lands. This was tried out by one grower during the season of 1920, and showed excellent results where a spotted infestation had occurred the previous season. In cases where trees or vegetation are left as protective wind breaks, the general spraying must be continued, but it is shown that in many cases the study of the local conditions will help the grower to combat this pest more easily. Great emphasis should be placed, however, on cultural and clean farming methods in attempts to control the grape berry moth.

THE EFFECT OF TIME OF SOWING UPON THE CONTROL OF THE WHEAT SHEATH WORM (*HARMOLITA VAGINICOLUM* DOANE)[1]

By T. H. Parks, *Ohio State University*

Observations commenced in 1918 and continued through four seasons, have pointed to time of sowing as an effective control for this injurious wheat insect in Ohio. The annual Wheat Insect Survey has given us data pertaining to both *Harmolita tritici* and this species with respect to date of sowing. Observations upon the development of *H. tritici* have not shown much relation between sowing dates and degree of infestation. In 1918, when observations were commenced with *H. vaginicolum*, it was apparent that time of sowing had a great deal to do with the degree of infestation. During that year in Northeastern Ohio all spring wheat and all late sowed winter wheat were badly infested with this insect, and the yields greatly reduced.

[1]Formerly genus Isosoma. Revised by Phillips and Emery, Proc. U.S. Nat. Mus. 55, pp.440.

The injury was first described by Doane[2] in 1916, who observed serious damage to occur on the dry farms of Utah. The adult insect lays several eggs in the leaf-sheath around the stem above the upper joint. The larvae developing within cells in the sheath, cause a swelling and hardening, which later results in the sheath above this point becoming much enlarged. If the plant is well developed at egg-laying time, the affected straw is short, and usually greatly distorted or bent at the upper joint. If the plants are quite young at the time of oviposition, the head is always stunted, and is often undeveloped or unable to push its way beyond the topmost leaf-sheath. Many straws do not get tall enough to be cut by the reaper. This is especially true of wheat growing in finishing furrows where growth has been retarded, and the straws are more suitable for the work of the insect. An infestation of 20% may mean a loss of one-fifth of the yield. The same infestation of *H. tritici* will probably reduce the yield but little, unless lodging occurs. *H. tritici* infested straws usually mature a satisfactory head.

In Ohio the injury due to *Harmolita vaginicolum* has been severe only in the northeastern counties. This includes ten counties east and northeast of Lorain, Wayne, and Harrison. During 1918 severe loss occured in this section to all wheat sowed after October 1st. Spring wheat suffered the worst. The injury decreased gradually until 1921, when joint-worm, was at a low ebb all over the State. During this year specimens of *H. vaginicolum* were taken along the Ohio River near the southern point of the State and at points in southeastern counties.

The surveyors did not observe any specimens in western Ohio. It is probably generally distributed over the eastern one-half of the State and most abundant in the northeastern section.

Date of sowing plats are maintained at most of the county experiment farms for the purpose of determining the best wheat sowing date through a series of years, and the effect of hessian fly upon wheat sowed at various times. Two of these county experiment farms, namely, Trumbull County and Mahoning County, have had the date of sowing plat going for five years. These counties are located in the section of the State where *H. vaginicolum* is the dominating species. Each year of the Wheat Insect Survey, except one, the writer has inspected these plats to determine the presence of this species and the effect of time of sowing upon its prevalence. In 1919, the data were collected by Mr. J. S. Houser of the Ohio Experiment Station. Usually 200 straws were examined and the percentage of infestation determined for the plat. These are here given for the years 1918—1921.

[2] *Isosoma vaginicolum*, Jour. of Econ. Ent., Vol. 9, No. 5, pp. 398.

PERCENTAGE OF STRAWS INFESTED BY HARMOLITA VAGINICOLUM

1918

Trumbull County (Experiment Farm)		*Mahoning County* (Stooksberry Farm)	
Sowed Sept 4	0%	Sowed Sept 2nd week	3%
" 15	Trace	Oct. 1st week	16%
" 22	11%	Nov 1st week	44%
Oct 1	19%		
" 10	32%		
Spring Wheat	21%		
Too young to detect.			

1919

		(Experiment Farm)	
Sowed Sept 9	0%	Sowed Sept 4	0%
" 18	0%	" 18	0%
" 23	0%	" 23	3%
Oct 1	0%	" 30	5%
" 10	0%	Oct 11	28%
Spring Wheat	67%	" 20	44%

1920

Sowed Sept 3	0%	Sowed Sept 2	Trace
" 9	Trace	" 12	0%
" 16	"	" 19	Trace
" 20	"	" 30	"
" 23	"	Oct 10	5%
Oct 2	1%	" 22	19%
" 14	10%		
" 23	22%		
Spring Wheat. Too young to detect.			

1921

Sowed Sept 29	Trace	Sowed Sept 1	¼%
Oct 7	"	" 10	½%
" 15	½%	" 20	1½%
" 26	1%	Oct 4	3%
Nov 5	2%	" 9	6%
Spring Wheat	1%	" 20	11%
		Spring Wheat	7%
		Too young to detect.	

From the data in the tables, it is seen that a very good control is secured in northeastern Ohio by avoiding the sowing of wheat after October 1st. Late sowed wheat and spring wheat suffered the most, the latter being very severely damaged, altho this damage did not show up until after the winter wheat was harvested.

The control of this species does not necessarily conflict with the control of hessian fly, when we consider that the fly-free sowing dates for this section of Ohio commence about September 23rd. There is then a period of time between the first fly-free dates and the first date of serious infestation from *H. vaginicolum*, during which time wheat may be sowed and avoid both insects. The length of this period apparently varies with the season, but it is usually sufficient to avoid a serious outbreak of either. In most years, sowing during this period of immunity will give protection from both of these insects.

SOURCES OF INFESTATION OF *THRIPS TABACI* IN IOWA

By J. L. HORSFALL, *Dubuque College, Dubuque, Iowa*

While employed as entomological assistant by the Iowa Experiment Station during the summer seasons of 1917–'18–'19 the writer was engaged in investigations of the Onion Thrips. During these investigations the following data were of particular interest in their bearing on the problem. In the vicinity of Davenport, Iowa, some five hundred acres are devoted to onion culture. From five to ten percent of this acreage is planted in set onions for the early market while the larger amount is grown from seed.

Records show that the thrips will establish themselves and begin breeding on set onions from two to three weeks earlier than on seed onions. From our life history studies we found fifteen days to be the average life cycle for *Thrips tabaci* during the last two weeks in June.

Thus the thrips have an opportunity to produce an early generation on the set onions. These will infest the seed onions in far greater numbers than would be the case were there no set onions grown in the neighborhood. Consequently, wherever set onions are planted in the vicinity of seed, they have proven a source of infestation for the later crop and it is doubtful whether the larger returns realized from the early crop compensate for this damage.

On June 24, 1919, the writer was called to investigate a report of thrips infestation in a 5 acre field of seed onions near Davenport. The onions in an area covering 4 square rods in the western corner of the field showed the characteristic yellowish "blight" which always indicates a severe infestation of thrips. This same field had been visited in the summers of 1917–'18 and was practically free from thrips both years. Across the fence from the infested corner was a 10-acre field of alfalfa which had been planted in 1918. This field had been in corn in 1917. The nearest field of onions to the west was two miles distant. On June 22, two days before the visit mentioned, the first cutting of alfalfa had been taken off. While the alfalfa was being cut the air was filled with flying thrips. This was mentioned especially by the farmer across the road who noticed them alighting on his clothing. The prevailing wind that day was from the east. Considering the above facts, it is evident that the alfalfa must have been the place of hibernation for the thrips and when this was cut they were induced to migrate. Since these insects fly with the wind they would only be carried over the west corner of the onion field. The resulting spread in this field was traced

from day to day as shown by the accompanying diagram (Figure 11). By the end of three weeks practically three-fourths of the field had been damaged.

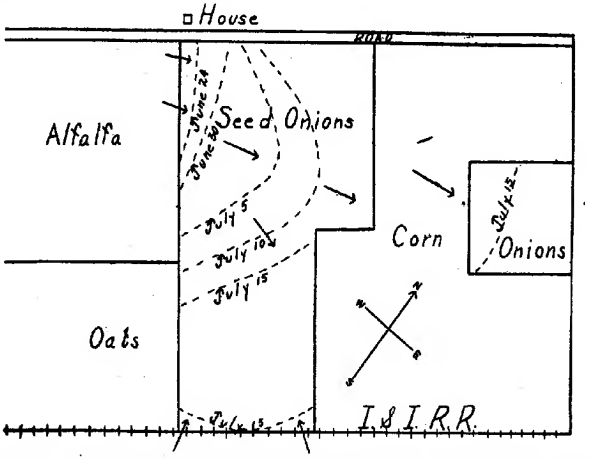


Fig. 11 Diagram illustrating infestation of onion field by THRIPS TABACI which had hibernated in field of alfalfa.

It is interesting to note in this connection that an adjacent cornfield did not serve as an obstruction to the spread of thrips as has often been supposed. By July 15, not only was the north end of the field covered by the pest, but also an area of "white blast" was to be found on the west side of a smaller field beyond the corn. The thrips had moved over the corn from the large field already mentioned. Control measures were attempted by the use of two knapsack sprayers, applying the nicotine sulphate spray advised by the U. S. Dept. of Agriculture, but negative results were obtained. Three hundred bushels of onions were harvested by this man from the five acres. This represented a loss of 75% over his 1918 crop. This loss was directly due to the infestation, since surrounding fields which were free from thrips yielded as much as four hundred bushels per acre under the same conditions of temperature and precipitation. Adults of *Thrips tabaci* were found in the alfalfa blossoms July 30 after the 1919 onion crop was harvested. It will be interesting to determine whether or not thrips will continue to winter over in the alfalfa field in the future and thus continue to menace the onion crop in that vicinity.

One serious outbreak of thrips in a field of set onions near Davenport was directly traceable to the fact that adjoining the sets the grower had six rows of perrenial multiplier onions. The thrips had wintered over on these and thus had an opportunity to begin breeding early. By June 19, they had spread over the first twenty rows of set onions seriously checking their growth. The further spread in this field was checked by the use of a Hardie barrel sprayer with hose extension to run between the rows. Nicotine sulphate–soap formula was employed.

Another source of spread was the greenhouses of the Davis Floral Co. near Davenport, Iowa. This concern is a large producer of hothouse tomatoes and cucumbers. Here the thrips had a chance to breed on the cucumbers through the winter and in the spring they spread from the houses to onion fields in the neighborhood. The first infestations noted in the fields in three different directions from the greenhouses were, in every case, on the side of the field nearest the greenhouses. Then, too, these attacks occurred from two to three weeks earlier than the infestations in other sections of the onion growing district. Attempts made by this company to grow onions in the near vicinity of the houses failed because of this early infestation by thrips which had emerged from the cucumber houses after breeding there during the winter.

One field of seed onions was visited in Mitchell County, Iowa, on August 26 where the source of infestation was very evident. This field of 10 acres was bordered along the east, south, and west sides by spruce trees forming a windbreak. At the east end of the field, well under these spruce trees, was a long pile of refuse where the tops and screenings of the 1918 season had been thrown when hauled from the field. An area heavily infested by the thrips was found to extend around the three sides of the field bordered by the spruce, but this area extended in the farthest at the east end. The thrips had evidently wintered in this pile of refuse and in the matted grass under the spruce.

A few other sources of infestation might be listed in addition to those already enumerated. In all cases they were factors because they had furnished protection to hibernating adults during the winter. In one field an area bordering an implement shed was the first part to become affected by the thrips. The tops of these onions were noticeably yellow while the rest of the field was still green. Upon examination, the tops of the onions near the sheds were found to be swarming with thrips whereas these insects could only be found deep in the sheaths of the onions over the rest of the field. In a field adjoining an orchard, the semi-circular region of "blast" appeared bordering the orchard. Where bluegrass and weeds along creeks, roads, or railroads were not burned,

an infestation usually resulted in the bordering onion fields. One field which bordered the railroad was practically free from thrips in 1919. When the grower was asked about his practice as to this, he answered that if the railroad company did not burn the grass in the fall and spring he always made it his business to see that it took fire. The matter of destruction, where possible, of places of hibernation is a phase of the problem of control which has been neglected too often by the growers, and yet it is one of the most powerful factors. Elimination of the sources of infestation is far easier and more economical than checking the pest after the outbreak begins.

WHITE-ANT-PROOF WOOD FOR THE TROPICS

By T. E. SNYDER, *Specialist in Forest Entomology, Bureau of Entomology, U. S. Department of Agriculture*

It is well known that white ants or termites are extremely destructive in the Tropics and that the woodwork of buildings and furniture must be constructed either of woods naturally resistant to attack or of woods chemically treated to prevent attack and rapid destruction.

Foreign manufacturers advertise "ant-proof" furniture for South American trade; American manufacturers have, as yet, not seriously competed.

Wood-pulp products, such as composition, ply and laminated wall boards, manufactured in the United States, also demand chemical treatment before they can be used in the Tropics.

Rather discouraging to American manufacturers, is the fact that due to spoiling the wood for fine finishing, cabinet woods can not be treated by the usual effective chemicals. A solution is given in the use of ant-proof woods imported from South America and other tropical countries as veneers glued upon cores of cheap American woods chemically treated. This well-known expedient is satisfactory, but there are other solutions of the problem.

A number of woods grown in the United States are very resistant to attack by white ants. Hence, since many of these woods are suitable for use as veneers, it is not necessary to import timber from the Tropics.

Furthermore, there is a chemical treatment for cabinet woods that, while it will somewhat darken the wood, if the wood is properly treated, permits shellac or varnish to adhere, and a suitable finish can be obtained. Wood treated with this chemical is both white-ant-resistant and

moisture-proof. The cost of this treatment is justified by this double effect and the fact that cabinet woods impregnated with this chemical can be advertised as white-ant-proof.

Wood-pulp products also can be rendered white-ant-proof by adding poisons in the process of manufacture.

Naturally Resistant Woods

In 1912 the Branch of Forest Entomology of the Bureau of Entomology, U. S. Department of Agriculture, began a series of tests of the relative effectiveness of treatments with chemical wood preservatives against attack by white ants at a field station at Falls Church, Va. In connection with these experiments, other service tests of the relative resistance of various native and tropical untreated woods to attack by white ants were begun in 1913.

The preliminary results of these tests, which are as yet incomplete and not conclusive, give some data of value. Certain species of wood appear to be naturally highly resistant to attack by white ants. This is not due to the element of hardness, since these insects will attack the hardest known wood, Lignum-vitae, but due to the presence in the wood of substances such as oils, alkaloids, etc., which are repellent or distasteful to white ants.

Normally the wood of pines is most susceptible to attack by white ants, but in case of certain pines with an extremely resinous heartwood, such as the "fatwood" of longleaf pine (*Pinus palustris*) of the southern United States, this is immune to attack by white ants; the excess of resin is a preventative. There is also some inherent principle in the heartwood of the red cedars (species of *Juniperus*) which renders it distasteful to white ants.

Species of native woods which might be used as veneers over chemically treated woods, or as ply or laminated woods, are listed in Table I, with their distribution in the United States, and their relative resistance to attack by white ants.

A few species valuable or which might prove useful for other purposes are also listed in this table.

Chemical Treatments for Finished Forest Products

The treatment for cabinet woods is impregnation with chlorinated naphthalene—a crystalline wax—by placing it in open vats of the wax, at a temperature of from 220 to 240° F., without previous drying of the wood[1]. The wood remains in the vats for periods varying with the dimensions of the wood; wood of ½ inch thickness requires but 15 minutes.

[1]Process devised by the Western Electric Company of New York, N. Y.

TABLE I. RELATIVE RESISTANCE OF SOME IMPORTANT[1] NORTH AMERICAN WOODS TO ATTACK BY WHITE ANTS (*Reticulitermes* spp.) AFTER A FIVE-YEAR TEST IN THE GROUND IN VIRGINIA

SPECIES OF WOOD	DISTRIBUTION IN THE U. S.	DEGREE OF RESISTANCE OF HEARTWOOD TO WHITE ANTS. *In Test.*	*In Nature.*[2]
Longleaf pine (*Pinus palustris*)	Southern U. S.	Heartwood ("fatwood") not attacked	Not attacked
Western larch (*Larix occidentalis*)	Cascade Mts. to Columbia River and to West. Mont., also Blue Mts.—Wash. & Ore.	Heartwood attacked, after 1½ years' test.	No data
Bald cypress (*Taxodium distichum*)	Southern U. S.	Heartwood not attacked	Attacked
Big tree (*Sequoia washingtoniana*)	Local in California	Heartwood not attacked	Not attacked
Red wood (*Sequoia sempervirens*)	Coast region of So. Oregon and California.	Heartwood not attacked	Not attacked
Incense cedar (*Libocedrus decurrens*r)	Oregon, California and Nevada.	Heartwood not attacked	Not attacked
Giant arborvitae or western red cedar (*Thuja plicata*)	Local in Southern Calif.	Heartwood not attacked	Not attacked
Monterey cypress (*Cupressus macrocarpa*)	Pacific Coast and Western slope Rocky Mts.	Heartwood not attacked	Attacked by *Kalotermes minor* Hag. in Calif.

[1]Species of woods badly attacked after 1 year's test are not listed, including:—pines, tamarack, spruce, Douglas fir (*Pseudotsuga taxifolia*), firs (*Abies*) and arborvitae (*Thuja*); also many hardwoods.

[2]Results based on observations in the field of the resistance of the wood under natural conditions where the tree grows.

Species of Wood	Distribution in the U. S.	Degree of Resistance of Heartwood to White Ants	
		In Test	*In Nature.*[2]
White cedar (*Chamaecyparis thyoides*)	Eastern U. S.	Heartwood not attacked	Attacked
Yellow cedar (*Chamaecyparis nootkatensis*)	Washington and Oregon	Slight attack after 1½ years' test.	Not attacked
Port Orford cedar (*Chamaecyparis lawsoniana*)	Southwest Oregon to California	Slight attack, after 1½ years' test.	Not attacked
Red juniper or red cedar (*Juniperus virginiana*)	Eastern and Central U. S.	Heartwood not attacked	Not attacked
Western juniper (*Juniperus occidentalis*)	Western Idaho, Cascade & Sierra Nevada Mts. to So. California.	Heartwood not attacked	Not attacked
Black walnut (*Juglans nigra*)	Eastern and Central U. S.	Heartwood attacked, after 2 years' test.	Attacked
Mesquite (*Prosopis juliflora*)	Southwestern U. S.—So. Okla. and Northern & Western Texas to So. California.	Heartwood not attacked	Attacked by *Amitermes wheeleri* Desn. in Texas.
Mahogany (*Swietenia mahogoni*)	Florida Keys	Heartwood attacked, after 2 years' test.	No data.

After removing the wood from the vats it should be carefully wiped off with cloth. The resultant color will be somewhat darker than the color of the untreated wood; care must be exercised in thoroughly cleaning the surface of the wood to insure the proper adherence of shellac or varnish.

The amount of wax taken up in the above treatment will vary with the different species of woods—whether they are open-pored or not—and according to the condition of the wood to be treated. A representative group[1] of both softwoods and hardwoods were treated with chlorinated naphthalene for our tests. This treatment renders the wood both white-ant-proof and moisture-proof to a marked degree. When treated with chlorinated naphthalene these sample sections of North American hardwoods, susceptible to attack if untreated, were not attacked, after burial in the ground for over three years with logs infested with white ants or termites (*Reticulitermes* spp.) in Virginia. After this severe test in the ground these treated woods compared favorably with untreated teak and mahogany as to general condition.

Similar samples of woods treated with paraffin wax were readily attacked by white ants and also suffered decay.

Chemical Treatments for Crude Forest Products

Construction timbers or other timber which is to be in contact with the ground should be impregnated with coal-tar creosote, which is a permanent preventative against attack by our native white ants or termites. Coal-tar creosote has many properties which would recommend its use in this respect, for it is also a fungicide, and, being insoluble in water, will not leach out in wet locations. These requirements furnish objections to many chemicals that otherwise are very effective insecticides.

The various methods of superficially treating timber, as by charring, by brushing, or by dipping with various chemical preservatives, among which are coal-tar creosotes, carbolineums, etc., have proven to be temporarily effective in preventing attack if the work is thoroughly done.

If the wood is not in contact with the ground, impregnation treatments with bichlorid of mercury and zinc chlorid are effective. The mercury and zinc in this form are both soluble in water.

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[1]White pine (*Pinus strobus*), black walnut, sweet birch (*Betula lenta*), chestnut, white oak (*Quercus alba*), red oak (*Quercus rubra*), sweet gum (*Liquidambar styraciflua*) mahogany (*Swietenia mahogoni*), sugar maple (*Acer saccharum*), white ash (*Fraxinus americana*).

The last named chemicals would be suitable treatments for cheap perishable woods to be used as the core, over which ant-proof veneers could be glued.

Chemical Treatments of Wood Pulp Products

In case of ply or laminated wall "boards" made of wood pulp, these boards may be made highly resistant to attack by white ants by adding poisons during the process of manufacture. Such poisons include solutions of bichlorid of mercury, carbolic acid, etc. Coal-tar creosote can be added where the brown stain and odor which are imparted to the board are not objectionable.

While white ants of the Tropics are more numerous and, as a rule, more destructive than those native to the United States, it is evident that if treated or untreated woods are resistant to attack by our native white ants (*Reticulitermes* spp.) after a severe five-year test in the ground, they will not readily be attacked when above ground by white ants of the Tropics; especially since our native white ants (*Reticulitermes* spp.) wherever they occur throughout the world are among the most destructive species to wood.

Opisthuria clandestina var. dorsalis Knight Injurious to Legumes.—In July of 1919 Mr. W. C. Abbott of the Extension Division of the Louisiana State University brought to the writer adults of a species of the heteropterous family Miridae, together with nymphs that appeared to belong to the same species, stating that they were taken from cowpeas, which they appeared to be injuring near Baton Rouge, La. No other observations concerning the habits of the species came to our attention until July 26, 1921, when adults and nymphs were found to be numerous on pole beans on a farm near Baton Rouge by Mr. W. G. Bradley, Assistant Entomologist of the Louisiana Experiment Stations. The upper surfaces of the leaves of these beans showed small white spots, often so numerous and close together as to give the surface a whitened appearance, similar to that caused by certain species of mites and thrips in their feeding on leaf tissue. The undersides of the leaves showed no signs of injury. The damage was so severe that the farmer had attempted to control the insect. Nymphs that were collected were carried through to the adult stage in confinement on bean leaves on which they caused the same type of injury as noted in the field.

A few adults and nymphs were also noted on soy beans on the Experiment Station farm at Baton Rouge during 1921.

Specimens collected from beans by Mr. Bradley have been referred to Dr. H. H. Knight of The University of Minnesota and determined by him as *Opisthuria clandestina* var. *dorsalis* Knight.

Thos. H. Jones, *Louisiana Experiment Stations*

LEAFHOPPERS INJURING WOODBINE

By GEO. W. BARBER, *Cereal and Forage Division, U. S. Department of Agriculture*

For the past two years the writer has noticed, from time to time, in several localities in Eastern Massachusetts, American Woodbine, *Speurer* spp. (*Ampelopsis, Parthenocissus*), injured by leafhoppers. During the season of 1920 it has been possible to determine the species concerned and to learn something of their life-histories and habits.

The following species are recorded:

Erythroneura comes var. comes Say.
Franklin, Aug. 22, 1920.

Erythroneura comes var. ziczac Walsh.
Arlington, June 3–14, 1920; Franklin, Aug. 22, 1920

Erythroneura comes var. elegans McAtee.
Lexington, April 16, 1920; Franklin, May 30, 1920;
Arlington, June 10, 1920; Franklin, Aug. 22, 1920;
Cambridge, Aug. 1919.

Erythroneura vulnerata var. vulnerata Fitch.
Franklin, May 30, 1920; Arlington, June 10, 1920;
Franklin, Aug. 22, 1920.

Erythroneura vulnerata var. nigra Gillette.
Arlington, June 3, 1920; Sudbury, July 6, 1920;
Franklin, July 28, 1920; and Aug. 26, 1920;
Lexington, July 28, 1920; Woburn, Sept. 3, 1920.

Of these forms *E. vulnerata var vulnerata* and *E. comes var. elegans* were throughout the season most numerous in the several localities, both being found together. *E. comes var ziczac* was at times abundant but *E. comes var. comes* and *E. vulnerata var. nigra* were infrequently seen and doubtless were present in small numbers.

The leaves by midsummer appear blotched and discolored, beginning to fall by the last of June. The continual falling of leaves is the most disagreeable feature of the insect attack where the plants are growing as shade for porches and summer houses.

Both species probably spend the winter as adults, since they were both taken in May to June before nymphs were in evidence. At that time the adults were few in number but by the middle of July were very numerous, together with nymphs of all stages. By September several instances were noticed where the remaining leaves on certain

vines were all spotted and the insects were most abundant. It seems probable that there are two and three broods in the latitude of Massachusetts.

Control of the species is rendered difficult in cases where the vines are climbing on the walls of buildings, since the nymphs are nearly all on the underside of the leaves and difficult to reach with a spray. Where the underside of the leaves can be reached, as on open porches and summer houses sprays of soap or nicotine solutions may be used and the writer has obtained effective control from a strong spray of water applied under considerable pressure and at intervals, directed towards the under surfaces of the leaves.

A SEED POTATO MAGGOT (*HYLEMYIA TRICHODACTYLA* RONDANI)

By O. A. JOHANNSEN, *Ithaca, N. Y.*

On June 27, 1910, I bred male specimens of an Anthomyiid fly, *Hylemyia* (*Phorbia*) *trichodactyla* Rondani from maggots infesting a lot of seed potatoes which had been forwarded to the Maine Agricultural Experiment Station from Aroostook Co., Maine, by a farmer who said his potatoes were severely infested.

Concerning the habits of this species but little has been published, though the adult fly is not uncommon. In the Cornell University Collection are specimens from Aroostook Co., Maine, Peru, N. Y., Ithaca, N. Y., Sandford, Ontario, and Truro, Nova Scotia; the collection dates ranging from May to July. Dr. O. Oberstein (Zeitschrift f. Pflanzenkrank. 24:385, 1914) records this species as injuring young cucumber plants in Lower Silesia where a one-half acre field under observation showed 80% injury. The maggots mined in the stems of the young plants causing them to die in a few days. When full grown the larvae descended into the soil where they pupated. The specimens which I had under observation remained in the pupal stage about one week.

As the fly has a wide distribution and is fairly common, it is not unlikely that it is of economic importance in the United States also, but by reason of its great similarity to the seed-corn fly (*Hylemyia cilicrura* Rondani =*H. fusciceps* Slingerland not Zetterstedt), it may have been mistaken at times for this species. The males of these two forms resemble each other in having the hind tibia ciliated on the inner (flexor) side (See Slingerland, Bulletin 78, Cornell Agricultural Experiment Station page 495), but differ in that *H. trichodactyla* has a few

long bristly hairs on the upper (extensor) side of the basal segment of the middle tarsus. For lack of bred material in which both sexes are associated, the female has not yet been sufficiently studied to distinguish it with certainty from that of *H. cilicrura*.

As for the larvae, the imported onion maggot, *Hylemyia antiqua* (=*cepetorum*), the seed corn maggot, *H. cilicrura*, the cabbage maggot, *H. brassicae*, and the seed potato maggot, *H. trichodactyla*, also resemble each other rather closely. The distinctive features of the first and third, are figured in Bulletin 200, N. J. Agr. Exp. Station, page 7; and the first three are figured by Gibson in Bulletin No. 12, Dept. of Agr., Dominion of Canada, 1916, page 12. The differential characters of the fourth, based on a study of my specimens, are given below. In *Hylemyia antiqua* and *H. cilicrura* the ventro-caudal papillae are simple; in *H. brassicae* and *H. trichodactyla* the two median ones are bifid. The last named species may further be distinguished from *H. brassicae* by the more distinctly chitinized condition and yellow color of the bifid papillae, the smaller size, and by the form of the mouth hooks. In *H. brassicae* the mouth hooks are robust and nearly smooth below; in *H. trichodactyla* they are smaller, slightly more pointed and slender, and uniformly serrate with about ten small teeth on the concave margin.

Until more light can be thrown upon the grouping of the closely related genera of the subfamily Anthomyiinae, I prefer to unite under the generic name *Hylemyia*, the genera *Chortophila*, (=*Phorbia*), *Hylemyia* sens. str., and the black legged species of *Pegomyia*.

It is desirable that economic entomologists who are working upon the habits of the Cabbage, Onion or Seed corn fly, keep in mind *Hylemyia trichodactyla*, with the hope that something more may be learned concerning its habits and its relation to farm crops.

A LAMP FOR TAXONOMIC WORK IN ENTOMOLOGY[1]

By W. J. PHILLIPS and F. W. POOS, *U. S. Bureau of Entomology, Charlottesville, Va.*

Taxonomic work on the genus *Harmolita*, of which many species are differentiated by the sculpturing of the propodia, requires both a magnification by high powered lenses and a very bright light. For this reason the writers have felt the need of better lighting facilities than those afforded by the common gooseneck type of electric lamp. A number of lamps of different manufacture have been tested. While these lamps gave sufficient light they were not only difficult to adjust but developed a great amount of heat, and were not economical in the use of electrical

[1]Published with the permission of the Secretary of Agriculture.

current. Professor A. L. Melander,[1] in 1913, briefly described an adaptation of an automobile headlight which he used for microscopic work. However the advantages of this type of lamp apparently have not been discovered by most taxonomic workers. It was therefore deemed advisable to give a detailed description of the lamp in use by the writers, together with a mounting which has been found most convenient and useful at this laboratory.

The lamp (Fig. 12.) adopted for use by the writers consists of the ordinary Ford spot light which is adjustable in both horizontal and vertical planes and carries a 6—8 volt, 32 candle-power bulb. It is mounted

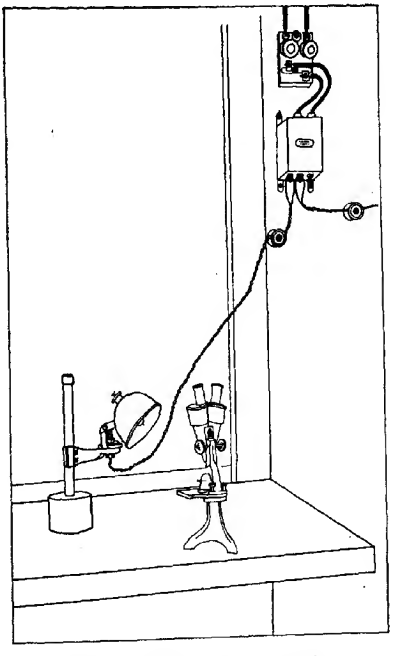

Fig. 12. Diagram of lamp installation.

on a home-made stand consisting of a fifteen inch length of one half inch, iron pipe with an elbow attached to the end which is mounted

[1]Jour. of N. Y. Ent. Soc. Vol. 21, 1913, p.227.

in a cement block. This block was molded in a coffee can and after the surface was smoothed with a trowel somewhat and the cement hardened, two coats of white paint were applied. A covering of felt was placed on the bottom of the stand.

A thordarson, type D, three-way step-down transformer, primary voltage 110, secondary voltage 6—8—14, 60 watt capacity, was used in order to attach the lamp to the ordinary 110 volt alternating current. Wherever direct current is used some other form of resistance will be necessary. It is safest to install a fuse block with fuse plugs of low amperage to protect the transformer. As many as three of these lamps may be attached to this transformer. The cost of this lamp depends upon the kind of transformer used which in turn depends upon the number of lamps desired and the candle-power of the bulbs which are used in the lamps. A rheostat may be used to regulate the intensity of illumination if this is desired. The retail price, at Charlottesville, Virginia, of three lamps, including one transformer as shown in figure 12, was $25.50 or and average of $8.50 per lamp, complete.

The chief advantages of this lamp are as follows: it furnishes a powerful light; develops very little heat; is economical in the use of electrical current; is easy on the eyes; is easily adjusted and installed and at the same time is comparatively inexpensive. These lamps have proven most satisfactory for our taxonomic work and they have also been used advantageously for photographic work with the Leitz Microscopic Camera.

THE ARGENTINE ANT BUILDS EARTHEN PROTECTIONS FOR MEALY BUGS[1]

By E. O. Essig

One of the most serious problems in connection with the control of many of the serious scale insects infesting orchard trees and other plants in California is the Argentine Ant, *Iridomyrmex humilis* Mayr, which so valiantly keeps away the natural enemies of the coccids.

Wherever the so-called biological method of pest control is employed, it is first necessary to take steps for the control of this ant in order to allow the proper freedom and development of the parasites and predators. For not only does the ant keep away the small hymenopterous parasites, but violently and effectively attacks the larger larvae of the ladybird

[1]Contribution from the Division of Entomology, University of California, Berkeley, California. Dec. 15, 1919.

beetles, lace wings and other allied predators. Besides such protection to the mealy bugs and other coccids, the ants carry them from plant to plant and sees to it that new colonies are constantly being formed until all of the shrubbery in an ant-infested district is well supplied with the plant destroying pests.

A very interesting method of protecting mealy bugs is at present being observed in a greenhouse in Berkeley. As is common in the vicinity, mealy bugs of several species, including the citrus mealy bug, *Pseudococcus citri* (Risso), Baker's mealy bug, *P. bakeri* Essig and the citrophilus mealy bug, *P. citrophilus* Clausen, are abundant; sometimes associated upon the same plant and often upon different hosts. But the Argentine Ant is abundant everywhere giving diligent attention to all. The particular greenhouse in question is given over to the culture of the Cape Jasmine, *Gardenia* sp., all of the plants of which are infested with the citrus mealy bug. The coccids are to be found only in the forks

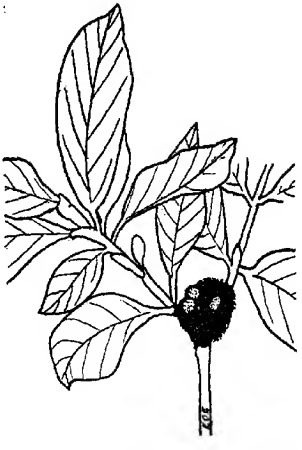

Fig. 13. Shelters constructed by Argentine ants.

of the branches near the tips of the plants and in some of the leaf axils singly or in small compact colonies. In the majority of cases the colonies are surrounded by very delicate earthen enclosures as shown in the accompanying illustration. These enclosures are usually oval or nearly spherical in shape and vary from a half to a full inch in diameter. The walls are exceedingly thin and delicate, being composed of fine particles

of dirt or leaf mold and attached to the branches of the forks for support. So frail are they that a slight sudden jar will cast them into ruin, but if destroyed the ants at once begin to construct new ones, apparently having already learned of their usefulness. Entrance to the enclosures is gained by one or several openings in the outside walls and through these the ants pass to and fro very freely.

This being the first time that I have seen anything just like this being constructed by the Argentine ant for the specific purpose of enclosing mealy bugs, it seemed worth recording the fact.

A HOME MADE MECHANICAL POISON BATE MIXER[1]

By B. G. THOMPSON, *Scientific Assistant, Bureau of Entomology, Cereal & Forage Insect Investigations*

During the grasshopper eradication campaign of the season of 1919 in Harney County, Oregon, which was carried on by the Entomological Extension Service, several mechanical devices were tried out for the mixing of poison bait. The apparatus hereinafter described, proved very successful both as a labor-saving device and as a means of securing an efficient and uniform mixture of poison bait.

The machine (See Fig. 14.) was constructed on the principle of a churn. It consisted of a wooden box 40" x 40" x 48", mounted on a 1¼" shaft, with a wooden pulley 42" in diameter, fastened firmly to the end

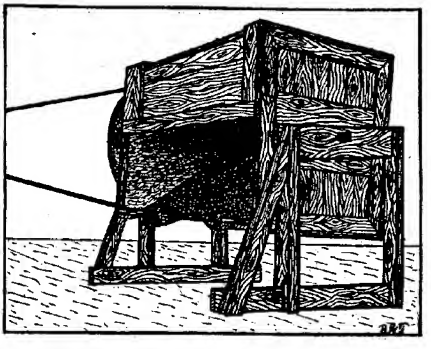

Fig. 14. Poison bait mixer.

of the box. The box was constructed of 1¼" tongue and grooved lumber. One half of one side was used as a door, thus giving ample

[1]By permission of the Secretary of Agriculture.

room for placing in the materials and taking out the bait. The edge of the door were felted to prevent leakage. No paddles or other obstructions were placed inside the box; the falling of the materials from one corner to another as the box revolved thoroughly mixed the bait.

It was necessary to use a 3½" pulley on the engine to get sufficiently low gear to turn the box about 36 revolutions per minute, which was found to be the maximum speed for best results. A one and one-half horse power gas engine developed sufficient power to operate the mixer. Two men operated it to its fullest capacity.

The machine handled 100 pounds of bran at a time. The bran and poison were placed in the box and mixed for about two minutes. The syrup, ground oranges, or lemons, and water, mixed together, were then added and mixed for from three to four minutes. The fact that there were no paddles or other obstructions in the box made the removal of the bait a simple matter. The bait was shoveled directly from the machine into sacks. This feature proved an advantage over a barrel-shaped mixer which required stationary paddles to thoroughly mix the bait.

Scientific Notes

Effect of Feeding Paradichlorobenzene-Treated Feed to Poultry. Last summer, corn in the Agronomy Seed Laboratories at Purdue University, was treated with para-di-chloro-benzene to eliminate if possible and to prevent further infestation by the angoumois grain-moth. Subsequently Prof. F. E. Robbins of the Agronomy Department used some of this corn for feeding poultry, resulting in tainting the flesh of the chickens to such an extent as to make it distasteful and inedible. Similarly eggs laid by hens fed this treated corn were equally distasteful and inedible. It has been previously noted that the eggs laid by hens fumigated with nitrobenzene for the control of lice and mites are spoiled for food.

J. J. DAVIS
Oct. 31, 1921, Lafayette, Ind.

Notes on the Nest and the Population of a Colony of Vespa diabolica. Prompted by a curiosity to learn something of the population of wasps' nests, I recently captured among others two colonies of *Vespa diabolica*. As is well known these build a nest not unlike that of various species of Polistes; but locate it in the ground instead of in some tree or shrub.

One of the nests was taken on September 26. The entrance on the surface of the ground was about an inch in diameter. It was inlaid with pieces of gravel that were held in place by a paper lining. By pouring a small quantity of carbon disulfide into the entrance the wasps were readily pacified, whereupon the nest with all the inhabitants was easily removed. The nest consists of six stories, and the base is about ten and a half inches in diameter.

The inhabitants of the nest numbered 2090. Of these there were 294 queens, 771 males, and 1025 workers. In the lower two stories there were still a large number of cells containing immature queens. The other nest was taken on August 23. While much smaller than the one just described, it nevertheless, consisted of six stories. The population numbered 146, consisting of 142 workers, 3 males, and one queen.

W. J. BAERG,
Fayetteville, Arkansas.

Artificial Production of Tipburn. Experiments conducted at the Iowa Experiment Station during the past season have proven that *Empoasca mali*, the potato leafhopper, is a very important factor in the production of tip- or hopperburn of potato. In July solutions were made by crushing a large number of these insects in both the mature and immature stages in sterile water. Small amounts of these solutions were injected into the leaves by various instruments, such as hypodermic needle and dissecting needle, and in every case within 24 hours a lesion was produced at the point of inoculation showing that these insects possess a toxic principle. Difficulty was experienced in getting large amounts of the solution into leaf tissue by these methods but in a few cases enough was injected to produce an injury decidedly similar to, if not identical with tipburn. Burning was produced where the extract was made from crushed adults. In another series of experiments when the young were crushed in a leaf abrasion a small but distinct lesion was produced after 24 hours, the tissue dying and turning brown at these points. When the extract made from crushed young was drawn up into the leaf by the natural transpiration of the plant, burning resulted that was similar to tipburn. In the latter experiments leaves were placed with their cut stems in the leafhopper extract. Solutions made by macerating tipburned leaf tissue in distilled sterilized water were injected into leaves by using a hypodermic needle. No injury resulted from these tests. Leaves inoculated with water alone failed to show injury and when dilute acids or alkalies were injected, the leaves wilted and then turned brown, a condition not comparable to tipburn. The above tests show that the potato leafhopper in both the young and adult stages does contain a toxic principle and that when enough of this is artificially injected into the leaf, tipburn results.

F. A. FENTON AND I. L. RESSLER
Iowa Experiment Station
Ames, Iowa.

Notes on a Bombylid Parasite and a Polyhedral Disease of the Southern Grass Worm, Laphygma frugiperda.—These notes are based on field observations made at Agricultural College, Mississippi and on records from several series of larvae collected in the field and reared in the laboratory simultaneously with the field observations. The Southern Grass Worm was very abundant in Mississippi during the summer of 1920 and offered an excellent opportunity for study of the parasites of which it is a host.

During the summer of 1920, two agencies of natural control were found in operation against the Southern Grass Worm, *Laphygma frugiperda*. One was a Bombylid parasite and the other a polyhedral disease, probably identical with one mentioned by Chapman and Glaser in the JOURNAL OF ECONOMIC ENTOMOLOGY Vol. 8, Feb., 1915.

The Bombylid was determined as *Anthrax lucifer* Fabr. by C. T. Greene of the U. S. Bureau of Entomology. The adult, a cloudy-winged, medium-sized bee-fly was observed to be very numerous during the late summer and early fall months,

hovering over pasture and meadow grass. It was reared from the larvae of the Southern Grass Worm in numbers sufficient to indicate that the parasitism was in no sense accidental. The larvae from which this parasite was recovered were taken from a heavy lawn infestation early in September, when about one-half grown. The parasitized larvae pupated successfully, but shortly after pupation, the parasite became fully developed and pupated within the pupal case of its host. After several days spent in this manner, the parasite pupa broke through and twisted itself entirely free from the pupal case of its host. Shortly after this the adult emerged. Since the Grass Worm pupates beneath the surface of the ground it seems quite probable that the active pupae of this parasite twists itself free from the host and works its way to the surface of the soil so that the adult may emerge directly into the open air. Seventy-two pupae were secured in these collections and eighteen or twenty-five per cent were parasitized by *Anthrax lucifer*.

The disease was first noted among nearly full-grown larvae in the same heavy lawn infestation, during the hot, humid weather of early September. Dead larvae in considerable numbers were found hanging from the tips of blades of grass. Those freshly dead presented a yellowish hue, but even in these the process of decomposition had advanced so far that the body contents had been reduced to milky fluid, which would break forth at the slightest pressure on the larval skin. Microscopic examination of a large series revealed that in all cases the body fluids of such larvae were crowded with highly refractive, irregularly angular bodies known as polyhedral bodies, and which are the distinguishing characteristic of one type of caterpillar maladies.

The existence of a polyhedral disease of the Southern Grass Worm has been previously noted, in connection with several diseases of a similar nature, the best known of which is the "wilt" disease of gipsy moth caterpillars.

From the disease infested colony of Grass Worm, two hundred and twenty-nine larvae were taken and maintained individually in glass vials. Of those that died, eighty-five had the typical appearance of polyhedral disease, and showed the presence of polyhedral bodies under the microscope, indicating a mortality of approximately thirty-seven per cent under laboratory conditions. This may have been somewhat higher than in the field, but all the field observations in this infestation indicate that it ran high, very many dead caterpillars being found. No disease of the Grass Worm was noted either in the field or in the laboratory prior to the outbreak mentioned above, although this insect was under observation throughout the season and several series of larvae had been reared in the laboratory during the previous months.

H. W. ALLEN.

Eggs of the Potato Flea Beetle (*Epitrix cucumeris*). I have several times been requested to state the means which were used in obtaining the eggs of the potato flea beetle (*Epitrix cucumeris*), the account of this process having been inadvertently omitted from Bulletin 211, Maine Agricultural Experiment Station. As it may be of interest to Economic Entomologists generally, it is given herewith.

The method is but a modification of one long in use and consists of enclosing beetles in a lantern globe set in a vertical position over a flower pot. The globe, closed top and bottom with cheese cloth, is set upon a piece of black paper kept damp by its contact with the earth in the flower pot. The beetles thrust the tips of their abdomens through the cloth and lay their eggs on top of the paper where they may readily be seen. The insects were captured in the field after the middle of June and soon thereafter laid their eggs.

Later, cages without bottoms were set over potted potato plants, care having been taken that the earth was free from eggs or larvae of any sort. *Sciara* larvae, in particular, are quite apt to be found in rich soil. The eggs of the flea bettle are only 0.25 mm. in length and are thus found with some difficulty at the base of the vines. Plants dug up about three weeks after the cages were charged with beetles, were found to have the larvae at their roots.

In the bulletin above mentioned, there is an error of omission which I take this occasion to rectify. On the bottom of page 42 the following words should be added; —"seed potato in the ground. In New York the larvae have been found boring in the tubers, the wound made resulting in the formation of a". It may also be noted that of all the species of *Sciara* mentioned on page 54 only *S. pauciseta* is North American.

O. A. JOHANNSEN

Reviews

An Abstract of the Legislation in Force in the British Empire Dealing with Plant Pests and Diseases up to the Year 1920. By E. MARGUERITE RALFS, Imperial Bureau of Entomology, London, pages 1-65, 1921.

This is an exceedingly useful compilation of the rules and regulations in relation to plant pests and diseases and relates, as indicated by its title, to the entire British Empire, including such widely separated parts of the world as Tasmania, Mauritius, various political divisions of Africa, India and Canada and its provinces. The restrictions and requirements are stated in non-technical language and some from the American standpoint would be onerous, if applied to certain areas in the United States, as for example the New South Wales requirement in relation to apple, pear and quince to the effect that infected and fallen fruit must be collected and destroyed regularly. The regulations apply to a large number of insects, plant diseases and plants. The utility of the compilation is greatly increased by a detailed index.

Entomologists will find much of interest in these regulations and those handling an extensive export business should certainly have a copy of this publication.

E. P. F.

Dr. Georgina Sweet, a thoroughly trained zoologist is in charge of the specia.. development along the lines of Economic Zoology, including Medical, Agricultural and Veterinary Zoology, recently inaugurated by the University of Melbourne. The need of literature is at times very acute and she would greatly appreciate publications relating to the above mentioned lines and being placed upon the exchange list of persons and institutions in a position to cooperate, though for the present she can not hope to offer much in the way of exchange. It is a gracious act to assist those remote from the great centers of scientific activity.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1921

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published as far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations as far as possible. Photoengravings may be obtained by authors at cost. The receipt of all papers will be acknowledged.—Eds.

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Illustrations are extremely valuable adjuncts to scientific papers and their free use should be encouraged, provided they elucidate a point or points and can be employed to as good or better advantage than their equivalent in text. The large amount of copy submitted for publication in connection with high printing rates has compelled most careful scrutiny of illustrations in order to secure the best results. There is no question but that an illustration in a scientific publication should tell a real story. It should do it as well and preferably better than text and applying the test of recent years in regard to printed matter, it should tell a hitherto unrecorded tale. The mere fact that an illustration represents a condition or process not heretofore known or described for one part of the country does not justify the expense of reproduction in a publication having a world wide circulation, though it could undoubtedly be used to excellent advantage in locally distributed literature.

Occasionally a considerable series of most excellent photographs are submitted. Limited resources make reductions imperative and in some cases most of the points can be clearly established by using only a portion of the series. Sometimes, an attempt is made to include too much on a plate. A few well engraved figures showing what is desirable are better than a larger number reduced so greatly as to obscure essential features. It is suggested that authors, with the above in mind study critically their illustrative material before submitting it for publication.

Current Notes

The Laboratory of the Bureau of Entomology at Cornelia, Ga., for the study of the codling moth, has been closed.

The annual meeting of the Michigan State Beekeepers Association was called for December 1 and 2, at Lansing.

Mr. C. R. Cleveland, formerly assistant entomologist at the New Hampshire Station, has been appointed assistant entomologist at the Indiana Station.

The annual convention of the Ontario Beekeepers Association was scheduled to be held at Toronto, November 22-23 in connection with the Royal Winter Fair.

Mr. H. L. Seamans recently appointed Entomologist in charge of the Dominion Entomological Laboratory at Lethbridge, Alberta, reported for duty on March 30.

According to *Science*, Professor F. E. Guyton, of the Ohio State University, has been appointed assistant professor of zoology and entomology at the Alabama Polytechnic Institute.

Professor F. Eric Millen, provincial apiarist of Ontario, has just returned from England where he spent part of his vacation and gave several lectures at meetings of beekeepers.

There has been a severe attack of the corn ear worm, *Chloridea obsoleta* Fabr., throughout southern Canada and the northeastern United States during September and October.

The Canadian Horticulturist and Beekeeper has been changed to *The Beekeeper*. Hereafter the publication will be devoted solely to the interests of apiculture and will be published at Petersboro, Ontario, as heretofore.

Mr. Harry Arnold, horticultural inspector of the Canadian Department of Agriculture, was killed at St. Catherines, Ont., October 23, by accidentally falling through an open trap, breaking his neck.

The valuable collection of aculeate Hymenoptera of the late F. W. L. Sladen, including a nearly complete collection of British wild bees, has been acquired by the Entomological Branch, Canadian Department of Agriculture.

Dr. J. M. Swaine of the Entomological Branch, Canadian Department of Agriculture, was elected President of the Professional Institute of the Civil Service of Canada at the annual meeting held in Ottawa, on November 1.

Mr. J. C. Bridwell of the Bureau of Entomology, when in New York recently made a study of the bruchid types of Schaeffer. He was fortunate in securing for study in Washingon the entire collection of Bruchidae belonging to Mr. Schaeffer.

Mr. Quincy S. Lowry, assistant director, Division of Plant Pest Control, Department of Agriculture, Boston, Mass., visited New York City and New Haven, Conn., on his vacation during the first week in November.

The annual convention of the Chicago Northwestern Beekeepers Association has been scheduled for December 5 and 6, at room 1811, Hotel La Salle, Chicago. Mr. John C. Bull, Valparaiso, Ind., is the Secretary.

Mr. W. O. Hollister, of the Davey Institute of Tree Surgery, Kent, Ohio, is President of the local Chamber of Commerce and has recently been elected mayor of the City of Kent. He takes his office January 1, 1922.

Mr. R. C. Treherne of the Vernon, B. C., Laboratory, has recently been appointed Chief of the Division of Field Crops and Garden Insects, Entomological Branch, Canadian Department of Agriculture, and took up his new duties in Ottawa, October 6.

The Alabama Beekeepers Association held its annual meeting at Montgomery on September 22. Steps were taken to secure a foul brood law at the forthcoming session of the legislature. It is stated that more bees and queens are reared within 150 miles of Montgomery than in any other equal section of the United States.

The following temporary officers resigned during October from the Entomological Branch, Canadian Department of Agriculture: G. M. McFarlane, junior entomologist, Saskatoon laboratory; Geo. Makinson, inspector, Nova Scotia; H. H. Thomas junior entomologist, British Columbia; A. H. McAndrews, spruce bud worm investigator, New Brunswick.

The following employees of the Bureau of Entomology have resigned to return to their studies in college: R. H. Turner and W. P. Whitlock; field assistants, Mexican bean beetle control; Bernard Smit, bean weevil investigations, Alhambra, Calif., to resume graduate work at Cornell University.

The following recent transfers in the Bureau of Entomology, U. S. Department of Agriculture have been announced: L. W. Brannon, D. M. Dowdell, Jr., H. B. Lancaster, F. R. White, temporary field assistants, Mexican bean beetle work, to plant quarantine inspectors, truck-crop insect investigations; M. H. Atwood, F. I. Jeffrey, E. G. Small, temporary field assistants, Mexican bean beetle work, to plant quarantine inspectors, Federal Horticultural Board; F. P. Bickley, Mexican bean beetle work to scientific assistant; E. R. Van Leeuwen, codling moth work at Cornelia, Ga., to camphor scale control, New Orleans, La.; A. J. Ackerman, Sacramento, Calif., to Bentonville, Ark., in charge of laboratory for apple insect investigations.

A conference was held on November 18, at 10:00 A. M., in the State House, Boston, Mass., to consider the gipsy moth situation, particularly the recent spread, the Federal and State appropriations and the outlining of a definite policy of carrying on the work for the coming season. This conference was called by Mr. William A. L. Bazeley, Commissioner of Conservation and State Forester of Massachusetts, and the conference was held in his office. The following were present: Prof. W. C. O'Kane, W. A. Osgood, New Hampshire; Harold L. Bailey, Vermont; W. A. L.

Bazeley, C. O. Bailey, G. A. Smith, Massachusetts; Dr. W. E. Britton, Connecticut; Dr. E. P. Felt, Dr. Geo. G. Atwood, New York; Messrs. A. F. Burgess, H. L. McIntyre and D. M. Rogers, Federal Bureau of Entomology.

On the night of November 2, 1921, a fire destroyed the building in which the Experiment Station laboratories of the Louisiana State University were housed. In common with other departments, the Department of Entomology lost all equipment, notes, specimens, publications, photographic plates, and correspondence. The Division of Truck Crop Insects of the U. S. Bureau of Entomology, which maintained a field station at Baton Rouge in co-operation with the Louisiana State University, also lost equipment, notes and specimens contained in the building.

Messrs. Strickland and Seamans of the Lethbridge, Alta. Laboratory, Entomological Branch, Canadian Department of Agriculture, visited Havre and Great Falls, Montana, the latter part of September to investigate the trap work being done in connection with the pale western cutworm. Bait traps at Havre show that more females than males are caught. Light traps are being used over a large area near Great Falls, the farmers have put 240 traps at the rate of one to a quarter section, and as large catches have been made, seem satisfied that the light traps are practical. Experiments on grasshoppers and cutworms are still being continued.

The following temporary officers resigned during September from the Canadian Entomological Branch: F. H. Randolph, Junior Entomologist, Mosquito Investigations; J. D. Sutherland, Insect Pests Investigator, Hemmingford Laboratory: R. S. Hawkins, Experimental Farms Assistant, Natural Control Investigations; R. N. Bissonette, Junior Entomologist, Division of Field Crop and Garden Insects; P. E. Donat, Insect Pests Investigator, Insecticide Investigations; H. A. Robertson, Junior Entomologist, Treesbank Laboratory; W. Carter, Junior Entomologist, Lethbridge Laboratory; R. H. Mowat, Experimental Farms Assistant, Division of Forest Insects; R. H. Painter, Insect Pests Investigator, Corn Borer Investigations; A. E. Cameron, Entomologist, Saskatoon Laboratory; G. P. Garlick, Junior Entomologist, Vineland Laboratory.

Prof. H. F. Wickham of the University of Iowa, special field agent in Mexican bean beetle investigations, Bureau of Entomology, returned September 21 from a preliminary survey of the Mexican bean beetle in its native home, Southern Mexico. Prof. Wickham entered Mexico August 6, and proceeded to Mexico City, which was made the headquarters for the investigations undertaken. Many observations were made on the growing of beans in the lowlands and in the mountains extending as far as an altitude of 10,000 feet. A number of varieties of beans were secured for experimental purposes, and observations with special reference to securing natural enemies and parasites were begun. In the vicinity of Cuernavaca the bean beetle occurred abundantly on wild legumes and was a most important bean pest. Near Orizaba the few beans found in cultivation were badly damaged. The beetle was not found in the vicinity of Guadalajara in Jalisco, although its nonoccurrence is not explained. A single specimen of a dipterous parasite of the larvae hitherto unknown was collected. Some promising information was obtained which completely justifies a more extensive investigation during the coming summer.

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